Experiments, Notes, &c.

ABOUT THE

Mechanical Origine or Production of divers Particular

QUALITIES:

Among which is inserted a Discourse of the

IMPERFECTION

OF THE

CHYMIST's Doctrine

OF

QUALITIES:

Together with some Reflections upon the

HYPOTHESIS

OF

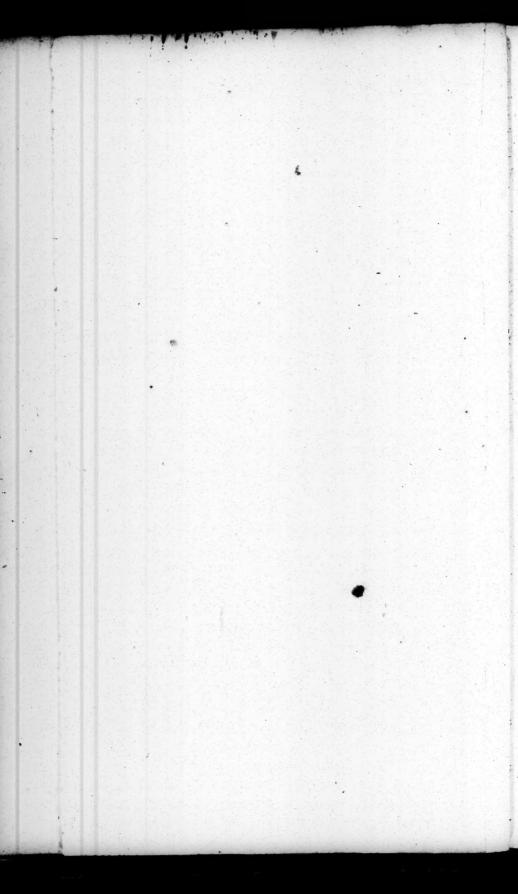
ALCALI and ACIDUM.

By the Honourable Robert Boyle, Esq; Fellow of the Royal Society.

The Second Edition.

LONDON

Printed, and Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-yard. 1690.



Directions for the Book-binder; to be put immediately after the general Title Page.

HE several Tracts of this Book are to be bound in the order

following, viz.

After the Preface of the Publisher to the Reader, and the Advertisements relating to the whole Treatise, is to follow,

1. The Tract of Heat and Cold.

2. Of Tafts.

3. Of Odours.

4. Of the impersection of the Chymists Doctrine of Qualities.

5. Reflexions upon the Hypothesis

of Alcali and Acidum.

6. Advertisements relating to Chymical Qualities, to be bound next after the Title Page to Volatility.

7. Of Volatility.

8. Of Fixtness.

9. Of Corrosiveness & Corrosibility.

10. Of Chymical Precipitation.

11. Of Magnetism.

12. Of Electricity.

*) ERRA-

ERRATA.

IN the Tract of Heat and Cold, p. 28. at the end of the page dele Finis, and go on to Exp. IX. p. 40. l. 21. r. degree of rapidness. p. 102. l. 15.

pur a comma after the word before.

In the Tract of Corrofiveness and Corrofibility read in the current Title on the top of p. 2. and 3. & seqq. Corrosiveness and Corrosibility, not or.

THE

PUBLISHER

TOTHE

Reader.

O keep the Reader from being at all surprized at the Date of the Title-Page, I must inform him, that a good part of the ensuing Tracts were Printed off, and in my custody, the last year; and the rest had come out with them divers moneths ago, if the Noble Author had not been hinder'd from committing them to the Press by the desire and hope of being able in a Short time to send them abroad more numerous, and by his being hinder'd to do so partly by Remove, partly by the want of some Papers that were odly lost or spoil'd, and partly by the sickness of himself, and divers of his near Rela-

To the Reader.

Relations. And some of these Impediments do yet suppress what the Author intended should have made a part of the Book, which now he suffers to be publish'd without them, though divers of his Papers about some other particular Qualities have been written so long ago, as to have lain for many years neglected among other of his old Writings: Which that he may have both leasure and health to review, and fit for publication, is the ardent wish of the sincere Lovers of Real Knowledge, who have reason to look on it as no mean proof of his constant kindness to Experimental Philosophy, that in these Tracts he perseveres in his course of freely and candidly communicating his Experiments and Observations to the publick, notwithstanding the liberty that hath been too boldly taken to mention them as their own by some later Writers; as particularly by the Compiler of the Treatise, entitul'd Polygraphice, who in two Chapters hath allow'd himself to present his Reader with alove Fifty Experiments, taken out of our

To the Reader.

our Authors Book of Colours, without owning any one of them to Him, or so much as naming him or his Book in either of those Chapters, nor, that I remember, in any of the others. Nor did I think this practice justified by the confession made in the Preface, importing, that the Compiler had taken the particulars he deliver'd from the Writings of others. For, this general and perfunctory acknowledgment neither doth right to particular Authors, nor, by naming them, enables the Reader to know, whether the things deliver'd come from persons fit to be credited or not: And therefore, since 'tis but too likely, that Such Concealment of the Names, if not Usurpation of the Labours of the Benefactors to Philosophy, will prove much more forbidding to many others to impart their Experiments, than as yet they have to our generous Author; it seems to be the Interest of the Commonwealth of Learning openly to difcountenance so discouraging a practice, and to shew, that they do not think it fit that Possessors of useful pieces of know-

To the Reader.

knowledge should be strongly tempted to envy them to the Publick, to the end onely that a few Compilers should not be put upon so reasonable and easie a work, as by a few words or names to shew themselves just, if not grateful.

But not to keep the Reader any longer from the perusal of these Tracts themselves, I shall conclude with intimating onely, that what our Author faith in one of them concerning the Insufficiency of the Chymical Hypothesis for explaining the Effects of Nature, is not at all intended by him to derogate from the Sober Professors of Chymistry, or to discourage them from useful Chymical Operations; for asmuch as I had the satisfaction, some years since, to see in the Authors hands a Discourse of his about the Usefulness of Chymistry for the Advancement of Natural Philosophy; with which also 'tis boped he will e're long gratifie the Publick.

ADVERTISEMENTS

Relating to the following

TREATISE.

O obviate some misapprehensions that may arise concerning the ensuing Notes about Particular Qualities, it may not be improper to adde something in this place to what has been faid in another + Paper + See Tracts about in reference to those Cosmical Qualities, &c. to which is prefixt Notes, and consequentan Introduction to the ly to premise to the History of Particular particular Experiments Qualities; Printed at some few general Ad- Oxford 1671. vertisements about them.

And I. we may consider, that there may be three differing ways of treating Historically of Particular Qualities. For either one may in a full and methodical History prosecute the Phænomena; or one may make a Collection of various Experiments and Observations whence may be gathered divers Phænomena to illustrate several, but not all of the Heads or Parts of such an ample or methodical History; or (in the third place) one may in a more

A 4 CC

confin'd way content ones felf to deliver fuch Experiments and Observations of the Production, or the Destruction or Change of this or that Quality, as, being duly reason'd on, may suffice to shew wherein the nature of that Quality doth consist, especially in opposition to thole erroneous coaceits that have been entertained about it. Of the First of these three ways of treating of a Quality I pretend not to have given any compleat example; but you will find, that I have begun such Histories in my Specimens about Fluidity and Firmness, and in the Experiments, Observations, &c. that I have put together about Cold. The Second fort of Historical Writings I have given an Instance of in my Experiments about Colours; but in these ensuing Notes, the occasion I had to make them having obliged me chiefly to have an eye to the difproval of the errours of the Peripateticks and the Chymists about them, I hope I shall not be thought to have fallen very short in my Attempt, if I have (here and there) perform'd what may be required in the Third way of writing Historically of a Quality; my present Design being chiefly to give an Intelligent and Historical Account of the Possible Mechanical Origination, not of the various PhePhanomena of the particular Qualities succinctly mentioned in these Notes; though, my secondary end being to become a Benefactor to the History of Qualities by providing Materials for my self or better Architects, I have not scrupled to adde to those, that tend more directly to discover the Nature or Essence of the Quality treated of, and to derive it from Mechanical Principles, some others (which happen'd to come in my way) that acquaint us but with some of the less luciferous Phænomena.

II. That you may not mistake what is driven at in many of the Experiments and Reasonings deliver'd or propos'd in the ensuing Notes about Particular Qualities, I must desire you to take notice with me, what it is that I pretend to offer you some proofs of. For, if I took upon me to demonstrate, that the Qualities of bodies eannot proceed from (what the Schools call) Subfantial Forms, or from any other Causes but Mechanical, it might be reafonably enough expected, that my Argument should directly exclude them all. But fince, in my Explications of Qualities, I pretend only, that they may be explicated by Mechanical Principles, without enquiring, whether they are explicable by any other; that which I need to prove, is,

not that Mechanical Principles are the necessary and onely things whereby Qualities may be explain'd, but the probably they will be found sufficient for their explication. And fince these are confessedly more manisest and more intelligible than substantial Forms and other Scholastic Entities (if I may so call them) 'tis obvious, what the consequence will be of our not being oblig'd to have recourse to things, whose existence is very disputable, and their nature very obscure.

There are feveral ways that may be employed, some on one occasion, and some on another, either more directly to reduce Qualities (as well as divers other things in nature) to Mechanical Principles; or, by shewing the insufficiency of the Peripatetic and Chymical Theories of Qualities, to recommend the Corpuscularian Do-

ctrine of them.

For further Illustration of this Point, I shall adde on this occasion, that there are three distinct forts of Experiments (besides other proofs) that may be reasonably employ'd, (though they be not equally estimated when we treat of the Origine of Qualities. For some Instances may be brought to shew, that the propos'd Quality may be Mechanically introduc'd into a portion of matter, where it

was not before. Other Instances there may be to shew, that by the same means the Quality may be notably varied as to degrees, or other not effential Attributes. And by some Instances also it may appear, that the Quality is Mechanically expell'd from, or abolish'd in, a portion of matter that was endow'd with it before. Sometimes also by the same Operation the former quality is destroyed, and a new one is produc'd. And each of these kinds of Inflances may be usefully employ'd in our Notes about Particular Qualities. to the first of them, there will be scarce any difficulty. And as to the fecond, fince the permanent Degrees as well as other Attributes of Qualities are faid to flow from (and do indeed depend upon) the same Principles that the Quality it self does; if, especially in bodies inanimate, a change barely Mechanical does notably and permanently alter the degree or other considerable attribute; it will afford, though not a clear proof, yet a probable presumption, that the Principles whereon the Quality it self depends are Mechanical. And lastly, if, by a bare Mechanical change of the internal Disposition and structure of a body, a permanent Quality, confess'd to flow from its substantial Form or inward Principle, be abolish'd.

olish'd, and perhaps also immediately succeeded by a new Quality Mechanically producible; if, I fay, this come to pass in a body Inanimate, especially if it be also. as to lense fimilar, such a Phanomenon will not a little favour that Hypothefis which teaches, that these Qualities depend upon certain contextures and other Mechanical Affections of the small parts of the bodies, that are indowed with them, and confequently may be abolish'd when that necessary Modification is destroyed. This is thus briefly premis'd to shew the pertinency of alledging differing kinds of Experiments and Phanomena in favour of the Corpuscular Hypothesis about Qualities.

What has been thus laid down, may, I hope, facilitate and shorten most of the remaining work of this Preamble, which is to shew, though but very briefly, that there may be several ways, not impertinently employable to recommend the Cor-

puscularian Doctrine of Qualities.

For first, it may sometimes be shewn, that a Substantial Form cannot be pretended to be the necessary Principle of this or that Quality; as will (for instance) hereaster be made manifest in the Asperity and Smoothness of bodies, and in the Magnetical Vertue residing in a piece of Iron that has been impregnated by a Loadstone.

strue, that the force of such Instances is indirect, and that they do not expressly prove the Hypothesis in whose favour they are alledged; but yet they may do it good service by disproving the Grounds and Conclusions of the Adversaries, and so (by removing Prejudices) making way for the better entertainment of the truth.

Secondly, we may sometimes obtain the same or the like Quality by Artificial and fometimes even temporary Compositions, which, being but factitious bodies, are by Learned Adversaries confess'd not to have Substantial Forms, and can indeed reafonably be prefum'd to have but refulting Temperaments: As will be hereafter exemplifi'd in the production of Green by compounding Blew and Yellow, and in the Electrical Faculty of Glass; and in the temporary whiteness produc'd by beating clear Oyl and fair Water into an Ointment, and by beating water into a froth, and, more permanently, in making Coral white by flawing it with heat; and in divers other Particulars, that will more properly be elsewhere mention'd.

Thirdly then, in some cases the Quality propos'd may be either introduced, or vary'd, or distroy'd in an inanimate body, when no change appears to be made in the bo-

olish'd, and perhaps also immediately succeeded by a new Quality Mechanically producible; if, I fay, this come to pass in a body Inanimate, especially if it be also. as to lenfe fimilar, fuch a Phanomenon will not a little favour that Hypothefis which teaches, that these Qualities depend upon certain contextures and other Mechanical Affections of the small parts of the bodies, that are indowed with them, and confequently may be abolish'd when that necessary Modification is destroyed. This is thus briefly premis'd to shew the pertinency of alledging differing kinds of Experiments and Phenomena in favour of the Corpuscular Hypothesis about Qualities.

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Thirdly then, in some cases the Quality propos'd may be either introduced, or vary'd, or distroy'd in an inanimate body, when no change appears to be made in the bo-

dy, except what is Mechanical, and what might be produc'd in it, supposing such a parcel of matter were artificially fram'd and constituted as the body is, though without any Substantial Form, or other fuch like internal Principle. So when a piece of Glass, or of clarify'd Rosin, is, by being beaten to powder, deprived of its Transparency, and made white, there appears no change to be made in the pulveriz'd body, but a comminution of it into a multitude of Corpuscles, that by their number and the various scituations of their furfaces are fitted copiously to reflect the fincere Light several ways, or give some peculiar Modification to its Rayes; and hinder that free passage of the beams of Light, that is requifite to Transparency.

Fourthly, as in the cases belonging to the foregoing number there appears not to intervene in the Patient or Subject of the change, any thing but a Mechanical alteration of the Mechanical Structure or Constitution; so in some other cases it appears not, that the Agent, whether natural or factitious, operates on the Patient otherwise than Mechanically, employing onely such a way of acting as may proceed from the Mechanisme of the matter, which it self consists of, and that of the

body

body it acts upon. As when Goldsmiths burnish a Plate or Vessel of Silver, that having been lately boil'd lookt white before. though they deprive it of the greatest part of its colour, and give it a new power of reflecting the beams of Light and vifible Objects, in the manner proper to specular bodies; yet all this is done by the intervention of a burnishing Tool, which often is but a piece of Steel or Iron conveniently shap'd; and all that this Burnisher does, is but to depre ssthelittle prominencies of the Silver, and reduce them, and the little cavites of it, to one physically level or plain Superficies. so when a Hammer striking often on a Nail, makes the head of it grow hot, the Hammer is but a purely Mechanical Agent, and works by local motion. And when by striking a lump of Glass, it breaks it into a multitude of small parts that compose a white powder, it acts as Mechanically in the production of that Whiteness as it does in driving in a Nail to the head. And so likewise, when the powder'd Glass or Colophony lately mention'd is, by the fire, from a white and opacous body, reduc'd into a colourless (or a reddish) and transparent one, it appears not, that the fire, though a natural Agent, need work otherwise than MechaMechanically, by colliquating the incoherent grains of powder into one mass; wherein, the ranks of pores not being broken and interrupted as before, the incident beams of Light are allow'd every

way a free passage through them.

Fifibly, the like Phænomena to those of a Quality to be explicated, or at least as difficult in the same kind, may be produc'd in bodies and cases, wherein 'tis plain we need not recurre to Substantial Forms. Thus a varying Colour, like that which is admired in a Pigeons Neck, may be produc'd in changeable Taffety, by a particular way of ranging and connecting Silk of feveral Colours into one piece of Stuff. Thus we have known Opals cafually imitated and almost excell'd by Glass, which luckily degenerated in the Furnace. And somewhat the like changeable and very delightful Colour I remember to have introduced into common Glass with Silver or with Gold and Mercury. So likewise meerly by blowing fine Crystal-Glass at the stame of a Lamp to a very extraordinary thinnels, we have made it to exhibit, and that vividly, all the Colours (as they speak) of the Rainbow; and this power of pleafing by diversifying the Light, the Glass, if well preserved, may keep for a long time. Thus alfo

also by barely beating Gold into such thin leaves as Artificers and Apothecaries are wont to employ, it will be brought to exhibite a green Colour, when you hold it against the Light, whether of the day, or of a good Candle; and this kind of Greenness as 'tis permanent in the foliated Gold, fo I have found by trial, that if the Sun-beams, somewhat united by a Burning-glass, be trajected through the expanded Leaf, and cast upon a piece of white paper, they will appear there as if they had been tinged in their passage. Nay, and sometimes a slight and almost momentany Mechanical change will feem to over rule Nature, and introduce into a body the quite opposite Quality to that the had given it: As when a piece of black Horn is, onely by being thinly fcraped with the edge of a knife or a piece of glass, reduced to permanently white Shavings. And to these Instances of Colours, some Emphatical and some Permanent, might be added divers belonging to other Qualities, but that I ought not to anticipate what you will elfewhere meet with.

There is yet another way of arguing in favour of the Corpuscularian Doctrine of Qualities, which, though it do not afford direct proofs of its being the best

Hypo-

Hypothefis, yet it may much ftrengthen the Arguments drawn from other Topicks, and thereby serve to recommend the Doctrine it self. For, the use of an Hypothefis being to render an intelligible account of the Causes of the Effects or Phænomena propos'd, without croffing the Laws of Nature or other Phænomena, the more numerous and the more various the Particulars are, whereof some are explicable by the affign'd Hypothesis, and some are agreeable to it, or at least are not dissonant from it, the more valuable is the Hypothesis, and the more likely to be true. For 'tis much more difficult, to finde an Hypothefis that is not true which will fuit with many Phænomena, especially if they be of various kinds, than but with few. And for this Reason I have fet down among the Instances belonging to particular Qualities some such Experiments and Observations, as we are now speaking of, since, although they be not direct proofs of the preferrabieness of our Doctrine, yet they may serve for Confirmation of it; though this be not the only or perhaps the chief Reason of their being mention'd. For whatever they may be as Arguments, fince they are matters of fact, I thought it not amiss to take this occasion of preserving them from being loft;

lost; fince, whether or no they contribute much to the establishment of the Mechanical Doctrine about Qualities, they will at least contribute to the Natural Hi-

story of them.

III. I shall not trouble the Reader with a Recital of those unlucky Accidents, that have hinder'd the Subjects of the following Book from being more numerous, and I hope he will the more eafily excuse their paucity, if he be advertised, that although the particular Qualities, about which some Experiments and Notes, by way of Specimens, are here presented, be not near half so many as were intended to be treated of; yet I was careful to chuse them such as might comprehend in a small number a great variety; there being scarce one fort of Qualities, of which there is not an Instance given in this small Book, fince therein Experiments and thoughts are deliver'd about Heat and Cold, which are the chief of the four FIRST QUALITIES; about Tafts and Odours, which are of those, that, being the immediate objects of Sense, are wont to be call'd SENSIBLE QUA-LITIES; about Volatility and Fixity, Corrosiveness and Corrosibility, which, as they are found in bodies purely natural, are referrable to those Qualities, that many B 2 PhysiPhysical Writers call SECOND QUA-LITIE'S, and which yet, as they may be produced and destroyed by the Chymists Art, may be sti'ed Chymical Qualities, and the Spagyrical ways of introducing or expelling them may be referr'd to Chymical Operations, of which there is given a more ample Specimen in the Mechanical account of Chymical Precipitations. And lastly, some Notes are added about Magnetismand Electricity, which are known to belong to

the Tribe of Occult Qualities.

IV. If a want of apt Coherence and exact Method be discover'd in the following Effays, 'tis hop'd, that defect will be easily excus'd by those that remember and confider, that these Papers were originally little better than a kind of Rapfody of Experiments, Thoughts, and Obfervations, occasionally thrown together by way of Annotations upon some Passages of a Discourse, (about the differing Parts and Redintegration of Nitre) wherein some things were pointed at relating to the particular Qualities that are here more largely treated of. And though the Particulars that concern some of these Qualities, were afterwards (to Supply the place of those borrow'd by other Papers whilft thefe lay by me) increas'd in number; yet it was not to be expected, that

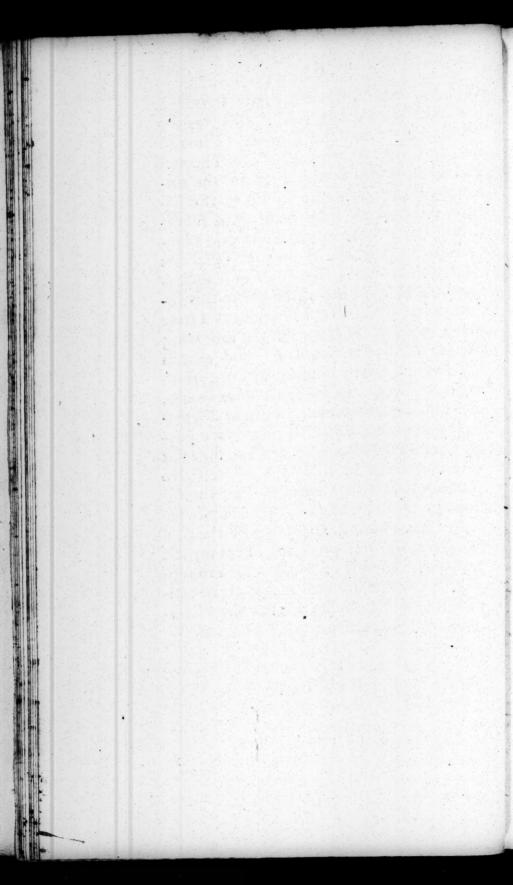
their Accession should as well correct the Form as augment the Matter of our Annotations. And as for the two Tracts, that are inserted among these Essays about Qualities; I mean the Discourse of the Impersection of the Chymical Doctrine of them, and the Resections on the Hypothesis of Acidum and Alcali, the occasion of their being made parts of this Book is so far express'd in the Tracts themselves, that I need not here trouble the Reader with

a particular Account of it.

V. I do not undertake, that all the following Accounts of Particular Qualities would prove to be the very true ones, nor every Explication the best that can be devis'd. For besides that the difficulty of the Subject, and Incompleatness of the History we yet have of Qualities, may well deterre a man, less diffident of his own abilities than I juftly am, from affuming so much to himself, it is not absolutely necessary to my present Design. For, Mechanical Explications of natural Phænomena do give so much more satisfaction to ingenious minds, than those that must employ Substantial Forms, Sympathy, Antipathy, &c. that the more judicious of the vulgar Philosophers themfelves prefer them before all others, when they can be had; (as is elsewhere shewn

at large,) but then they look upon them either as confined to Mechanical Engines, or at least but as reaching to very few of Nature's Phanomena, and, for that reason, unfit to be received as Physical Principles. To remove therefore this grand Prejudice and Objection, which feems to be the chief thing that has kept off Rational Inquirers from cloting with the Mechanical Philofophy, it may be very conducive, if not fufficient, to propose such Mechanical accounts of Particular Qualities themselves, as are intelligible and possible, and are agreeable to the Phanomena whereto they are applied. And to this it is no more necessary that the account propos'd should be the truest and best that can possibly be given, than it is to the proving that a Clock is not acted by a vital Principle, (as those Chineses thought, who took the first, that was brought them out of Eurape, for an Animal,) but acts as an Engine, to do more than affign a Mechanical Structure made up of Wheels, a Spring, a Hammer, and other Mechanical pieces, that will regularly shew and strike the hour, whether this Contrivance be or be not the very fame with that of the Particular Clock propos'd; which may indeed be made to move either with Springs or Weights, and may consist of a greater or lesser number of Wheels.

Wheels, and those differingly scituated and connected; but for all this variety 'twill still be but an Engine. I intend not therefore by proposing the Theories and Conjectures ventur'd at in the following Papers, to debar my felf of the Liberty either of altering them, or of fubttituting others in their places, in case a further progress in the History of Qualities shall suggest better Hypotheses or Explications. And 'twas but agreeable to this Intention of mine, that I should, as I have done, on divers occasions in the following Notes, imploy the word Or, and express my felf fomewhat doubtingly, mentioning more than one Cause of a Phanomenon. or Reason of an opinion, without dogmatically declaring for either; lince my purpose in these Notes was rather to shew, it was not necessary to betake our selves to the Scholastick or Chymical Doctrine about Qualities, than to act the Umpire between the differing Hypotheles of the Corpuscularians; and, provided I kept my self within the bounds of Mechanical Philosophy, my defign allowed me a great latitude in making explications of the Phanemena, I had occasion to take notice of.



OF THE

MECHANICAL ORIGINE

OF

HEAT and COLD.

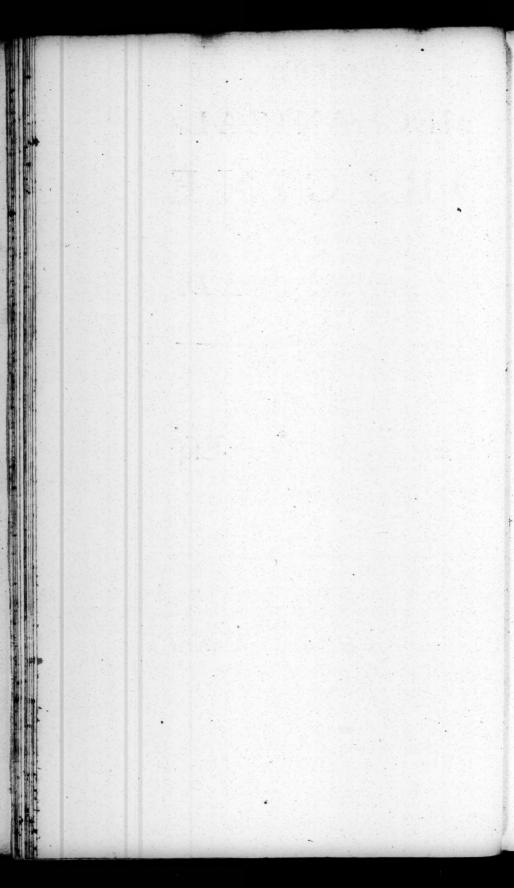
By the Honourable

ROBERT BOYLE Efq;

Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.



Experiments and Notes

ABOUT THE

MECHANICAL ORIGINE

OR

PRODUCTION

OF

HEAT and COLD.

SECT. I.

About the Mechanical Production of Cold.

lookt upon as the most active among Qualities, from which many other Qualities are deducible, and by which many of Nature's Phænomena, especially among the A 2 Peri-

2 Df the Wechanical Dzigine

Peripateticks, are attempted to be explicated; I suppose it will be very proper to begin with Instances of them to shew, that Qualities may be Mechanically produced or destroy-ed. A not useless Paraphrase of which expression may be this, That a portion of matter may come to be endowed with a Quality, which it had not before, or to be deprived of one that it had, or (fometimes) to acquire or lose a degree of that Quality; though on the part of the Matter (or, as some would speak, of the Patient) there do not appear to intervene any more than a change of Texture, or some other Mechanical Alteration; and though the Agents (on their part) do not appear to act upon it otherwise, than after a Mechanical manner, that is, by their bigness, shape, motion, and those other Attributes by vertue whereof Mechanical Powers and Engines perform their operations; and this without having recourse to the Peripatetic Substantial Forms and Elements,

ments, or to the Hypostatical Princi-

ples of the Chymists.

And having here (as in a proper place) to avoid ambiguity, premifed once for all, this

*Summary Declaratiin the Preamble.

on of the sense, agreeably whereunto I would have these Terms understood in the following Notes about the Origine of Particular Qualities; I proceed now to set down some few examples of the Mechanical Production of Cold & Heat, beginning with those that relate to the former, because by reason of their Paucity they will be quickly dif-And I hope I shall not need to make an Apology for mentioning no greater number; fince I scarce remember to have met with any Instances of this kind in any of the Claffick Writers of Natural Philo-Sophy.

4 Of the Bechanical Dzigine

EXPER. I.

MY first Experiment is afforded me by the Dissolution of Sal Armoniac, which I have somewhat wonder'd, that Chymists having often occasion to purifie that Salt by the help of Water, should not have, long fince, and publickly, taken no-tice of. For if you put into three or four times its weight of Water a pound or but half a pound (or even less) of powder'd Sal Armoniack, and stir it about to hasten the dissolution, there will be produc'd in the mixture a very intense degree of Coldness, such as will not be onely very sensible to his hand that holds the Glass whilst the Dissolution is making, but will very manifestly discover it self by its Operation upon a Thermoscope. Nay, I have more than once by wetting the outfide of the Glass, where the dissolution was making, and nimbly stirring

ring the Mixture, turn'd that externally adhering water into real Ice, (that was scrap'd off with a knife) in less than a minute of an hour. And this thus generated Cold continued considerably intense, whilst the action of dissolution lasted; but afterwards by degrees abated, and within a very few hours ceas'd. The particular Phænomena I have noted in the Experiment, and the practical uses that may be made of it I reserve for another place *, the * Divers of the knowledge of them be-Phænomena, &c. ing not necessary in of this Experiment were afterthis, where what I have wards printed already related, may Numb. 15. of the Ph. Tranfact. suffice for my present

Argument.

And to shew, that not onely a far more intense degree of Cold may emerge in this Mixture, than was to be found in either of the Ingredients before they were mingled, but a considerable Coldness may be begun to be produc'd between Bodies that were neither of them actually Cold A 4 before

6 Di the Bechanical Dzigine before they were put together, I will subjoin a Transcript of what I find to this purpose among my Adversaria.

EXPER. II.

TRemember that once I had a mind I to try, Whether the Coldness produced upon the Solution of beaten Sal Armoniac in water, might not be more probably referr'd to some change of Texture or Motion resulting from the action of the Liquor upon the Salt, than to any Infrigidation of the water made by the suddain dispersion of so many Saline grains of powder, which by reason of their Solidity may be suspected to be actually more cold than the Water they are put into; I therefore provided a Glass full of that Liquor, and having brought it to such a Temper, that its warmth made the Spirit of Wine in the feal'd Weather-glass mamanifestly, though not nimbly, afcend; I took out the Thermoscope, and laid it in powder'd Sal Armoniac, warm'd beforehand; so that the tincted Liquor was made to ascend much nimblier by the Salt than just before by the Water; and having presently remov'd the Instrument into that Liquor again, and poured the somewhat warm Sal Armoniac into the same, I found, as I imagin'd, that within a space of time which I guess'd to be about half a minute or less, the Spirit of Wine began hastily to subside, and within a few minutes fell above a whole division and a quarter below the mark at which it stood in the water, before that Liquor or the Salt were warm'd. Nor did the Spirit in a great while reascend to the height which it had. when the water was cold.

The same Experiment, being at another time reiterated, was tried with the like success; which second may therefore serve for a Confirmation of the first.

EXPER.

EXPER. III.

Having a mind likewise to shew some Ingenious men, how much the production of Heat and Cold depends upon Texture and other Mechanical Affections, I thought fit to make again a Sal Armoniac by a way I formerly publish'd, that I might be fure to know what Ingredients I employ'd, and shew their effects as well before conjunction as after it. I took then Spirit of Salt, and Spirit of fermented or rather putrified Urine; and having put a feal'd Weather-glass into an open Vessel, where one of them was pour'd in, I put the other by degrees to it, and observ'd, that, as upon their mingling they made a great noise with many bubbles, so in this conflict they lost their former coldness, and impell'd up the Spirit of Wine in the seal'd Thermoscope: Then slowly evaporating the superfluous moisture, I obtained

tained a fine fort of Sal Armoniac for the most part figur'd not unlike the other, when being dissolv'd and siltrated, it is warily coagulated. This new Salt being gently dry'd I put into a wide Glass of water, wherein I had before plac'd a seal'd Weatherglass, that the included Spirit might acquire the temper of the ambient Liquor, and having stirr'd this Salt in the water, though I took it then off the mantle-tree of a Chimney that had had fire in it divers hours before, it did, as I expected, make the tincted Spirit hastily subside and fall considerably low.

EXPER. IV.

Since if two bodies upon their mixture acquire a greater degree of Cold than either of them had before there is a production of this additional degree of that Quality, it will

will be proper to add on this occasi-

on the ensuing Experiment.

We took a competent quantity of acid spirit distill'd from Roch-allom, (that, though rectifi'd, was but weak,) which, in the spirit of that falt, is not strange. Of this we put into a wide mouth'd Glass (that was not great) more than was sufficient to cover the globulous part of a good feal'd Thermoscope, and then suffering the instrument to stay a pretty while in the liquor, that the Spirit of wine might be cool'd as much as the ambient was, we put in little by little some volatile salt sublimed from Sal Armoniac and a fixt Alcali, and notwithstanding the very numerous (but not great) bubbles, and the noise and froath that were produced, as is usual upon the reaction of Acids and Alcalys, the tincted spirit in the Weather-glass, after having continued a good while at a stand, began a little to descend, and continued (though but very flowly) to do fo, till the spirit of Allom was glutted with

with the volatile falt; and this defcent of the tincted liquor in the Instrument being measur'd, appear'd to be about an inch (for it manifeltly exceeded seven eighths.) By comparing this Experiment with the first part of the foregoing, we may gather, that when Volatile and Urinous Salts or Spirits (for the faline particles appear fometimes in a dry and fometimes in a liquid form) tumultuate upon their being mixt with Acids, neither the Heat nor the Cold that ensues is produc'd by a Conflict with the Acids precifely as it is Acid, fince we have seen that an urinous spirit produc'd an actual Heat with spirit of Salt, and the distill'd Salt of Sal Armoniac, which is also Urinous, with the acid spirit of Roch-Allom produces not a true effervescence, but a manifest Coldness: As the same Salt also did in a Trial of another fort, which was this.

EXPER. V.

Vitriol, and shaking it into twelve parts of water we made a mixture, that at first was sensibly warm; then suffering this to cool, we put a sufficient quantity of it into a wide mouth'd glass, and then we put a good Thermoscope Hermetically feal'd, above whose Ball the compounded liquor reached a pretty way. After some time had been allowed that the liquor in the Thermometer might acquire the temper of the ambient; we put in by degrees as much volatile Salt of Sal Armoniac as would serve to satiate the acid spirits of the mixture: for, though these two made a notable conflict with tumult, noise, and froth, yet 'twas but a cold ebullition (if I may so stile it,) for the spirit in the Thermoscope descended about an inch beneath the mark it rested at, when the seeming effervescence began. EX.

EXPER. VI.

Is known that Salt-peter being put into common water produces a sensible Coldness in it, as it also does in many other Liquors: But that the same Salt put into a Liquor of another Constitution may have a quite differing effect, I have convinc'd some inquisitive persons by mingling eight ounces of fine Saltpeter powder'd with fix ounces of Oyl of Vitriol: For by that commixture with a Salt that was not only actually, but, as to many other bodies, potentially cold, the Oyl of Vitriol, that was sensibly cold before, quickly conceived a confiderable degree of Heat, whose Effects also became visible in the copious Fumes that were emitted by the incalescent Mixture.

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EXPER. VII.

His brings into my mind, that though Gunpowder seems to be of so igneous a nature, that, when 'tis put upon a Coal, it is turn'd presently into slame capable of promoting the deslagration of the Charcoal, and kindling divers bodies it meets with in its way; yet if some ounces of Gunpowder reduced to powder be thrown into sour or sive times as much water, it will very manifestly impart a Coldness to it, as experience made with, as well as without, a seal'd Thermoscope has assured me.

This and the foregoing Experiment do readily suggest an Inquiry into the nature of the Coldness, which Philosophers are wont to oppose to that which immediately and upon the first contact affect the organs of sense, and which therefore they call Actual or Formal.

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The success of this Experiment upon a second trial serv'd to confirm it, which is the more strange, because I have found, that a small quantity of Oyl of Vitriol, not beforehand mingled with water, would produce a notable heat in its conflict with a small portion of just such Salt as I employed before (both the parcels having been, if I well remember, taken out of the same Glass.) And this heat did upon trial, made with the former Thermoscope, make the tincted Spirit ascend much surther than the lately recited Experiment made it subside.

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DIGRESSION

ABOUT

POTENTIAL COLDNESS.

Otential Coldness has been generally lookt upon, and that partly perhaps upon the score of its very name, as so abstruse a Quality, that 'tis not onely rational but necessary to derive it from the Substantial Forms of bodies. But I confess I see no necessity of believing it not to be referrable to Mechanical Principles. For as to the chief Instances of Potential Coldness, which are taken from the effects of some Medicines and aliments in the bodies of men, it may be faid without improbability, that the produced Refrigeration proceeds chiefly from this, that the potentially cold

cold body is made up of Corpufcles of such size, shape, &c. that being resolved and disjoined by the Menstruum of the stomach, or the fluids it may elsewhere meet with, they do so associate themselves with the small parts of the blood and other liquors, as, by clogging them or otherwise, to lessen their wonted agitation, and perhaps make them act in a peculiar way as well as less briskly on the nervous and fibrous parts; and the perception of this Imminution (and perhaps change) of motion in the organs of feeling is that, which, being referr'd to the body that produces it, we call its Potential Coldness. Which Quality appears by this account to be, as I was saying before, but a Relative thing, and is wont to require the diffusion or dispersion of the small parts of the Corpuscles of the Agent, and their mingling themselves with the liquors or the small parts of the body they are to refrigerate: And therefore, if it be granted, that B 2

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in Agues there is some morbifick matter of a viscous or not easily diffipable texture, that is harbor'd in iome part of the body, and requires fuch a time to be made fluid and resolvable; the Cold Fits of Agues need not be so much admired as they usually are; since, though just before the Fit the same parcel of matter that is to produce it were actually in the body, yet it was not by reafon of its clamminess actually resolved into small parts, and mingled with those of the bloud, and consequently could not make such a change in the motion of that liquor as is felt in the Cold Fit of an Ague; (for, of the further Change that occasions the Hot Fit, I am not here to speak) And in some other Dis eafes a small quantity of matter, being resolved into minute parts, may be able to produce a great sense of Coldness in some part of a body, which by reason of the structure of that part may be peculiarly disposed to be affected thereby; as

I have known Hypochondriack and Hysterical women complain of great Degrees of Coldness, that would suddenly invade some particular part, chiefly of the Head or Back, and be for a good while troublesome there. And that, if a frigorific vapour or matter be exceeding subtile, an inconsiderable Quantity of it being dispersed through the bloud may suffice to produce a notable Refrigeration, I have learnt by Inquiry into the Effects of some Poysons; and 'tis not very material, whether the Poyson, generally speaking, be cold or hot, if it meet with a body dispos'd to have those affections that pass for cold ones produced in it. For I have made a Chymical Liquor, that was penetrant and fiery enough to the Taste, and had acquired a Subtlety and briskness from Distillation, with which I could almost in a trice, giving it but in the quantity of about a drop, cast an Animal into that which appear'd a sleep, and the like Liquor

Liquor, in a not much greater quantity, being, by I know not whose mistake, apply'd to the aking Tooth of a very Ingenious Person, did presently, as he soon after told me, give him an universal Refrigeration, and trembling, worse than the cold Paroxisme of a Quartane. And though Scorpions do sometimes cause, by their sting, violent Heats in the parts they hurt, yet fometimes also the quite contrary happens, and their Poyson proves, in a high degree, potentially cold; as may be learnt from the two following Observations recorded by eminent Physicians.*Fa-* Eeniven. cap. 56. Abditorum mulum habui, (faith Beapud Schenk. nivenius) qui à Scorpi-Lib. 7. de venen. Observ. 24. one ichus, tam subito ac tam frigido sudore toto corpore perfusus est, ut algentissimà nive atque glacie sese opprimi quereretur. Verum cum algenti illi solam Theriacam ex vino potentiore exhibuisem, illico curatus est: Thus far he: To whose Narrative I adde this of Amatus Lusitanus.

Vir qui à Scorpione in manus digito punctus fuit, cent. 6. Observ. multum dolebat, & refrigeratus totus contremebat, & per corpus dolores, cute totà quasi acu punctà, formicantes pa-

tiebatur, &c.

I cannot now stay to enquire, Whether there may not be in these great Refrigerations, made by so small a quantity of Poyson, some small Concretions or Coagulations made of the minute particles of the bloud into little clots, less agile and more unwieldy than they were when they moved separately: which may be illustrated by the little Curdlings that may be made of the parts of Milk by a very small proportion of Runnet or some acid liquor, and the little coagulations made of the Spirit of Wine by that of Urine: Nor will I now enquire, whether, besides the retardment of the motion of the bloud, some poysons and other analogous Agents may not give the motion of it a new modification, (as if fome Corpuscles that usually are B 4 more

more whirl'd or brandish'd be put into a more direct Motion) that may give it a peculiar kind of grating or other action upon the ners vous and fibrous parts of the body. These, I say, and other suspicions that have sometimes come into my thoughts, I must not stay to examine; but shall now rather offer to Confideration, Whether, fince fome parts of the humane body are very differing from others in their structure and internal Constitution; and fince also some Agents may abound in Corpuscles of differing shapes, bulks, and motions, the same Medicine may not in reference to the same humane body be potentially cold or potentially hot, according as 'tis applied; or perhaps may, upon one or both of the accounts newly mentioned, be cold in reference to one part of the body, and hot in reference to the other. And these effects need not be always ascrib'd to the meer and immediate action of the Corpuscles of the Medicine, but some.

fometimes to the new Quality they acquire in their Passage by associating themselves with the bloud or other fluids of the body, or to the expulsion of some calorific or frigorific Corpuscles, or to the Disposition they give the part on which they operate, to be more or less permeated and agitated than before by some subtile æthereal matter, or other Efficients of Heat or Cold. Some of these Conjectures about the Relative Nature of Potentially cold bodies, may be either confirmed or illustrated by such Instances as these; that Spirit of Wine being inwardly taken is potentially very hot, and yet being outwardly applied fome Burns and fome hot Tumours does notably abate the Heat of the inflamed parts, though the same Spirit applied even outwardly to a tender eye will cause a great and dolorous agitation in it. And Camphire, which in the Dose of less than a half or perhaps a quarter of a Scruple, has been observed to diffule

fuse a Heat through the body, is with success externally applied by Physicians and Chirurgeons in refri-

gerating Medicines.

But I leave the further Inquiry into the Operations of Medicines to Physicians, who may possibly, by what has been said, be assisted to compose the differences between some famous Writers about the temperament of some Medicines, as Mercury, Camphire, Oc. which some will have to be cold, and others maintain to be hot; and shall onely offer by way of confirming, in general, that Potential Coldness is onely a Relative Quality, a few Particulars; the first whereof is afforded by comparing together the VI. and the VII. Experiment before going, (which have occasion'd this Digreffion about Potential Coldness;) fince by them it seems probable, that the same thing may have it in reference to one body, and not to another, according to the disposition of the body it operates upon, or that operates

rates upon it. And the Fumes of Lead have been observed sometimes (for I have not found the Effect to succeed always) to arrest the suidity of Mercury, which change is supposed to be the effect of a Potential Coldness belonging to the Chymists Saturn in reference to suid Mercury, though it have not that operation on any other liquor that we know of.

And lastly, (for I would not be too prolix) though Nitre and Sal Armoniac be both apart and joyntly Cold in reference to Water, and though, however Nitre be throughly melted in a Crucible, it will not take fire of it self, yet if, whilst it is in Fusion, you shall by degrees cast on it some powder'd Sal Armoniac, it will take fire and slash vehemently, almost as if Sulphur had been injected.

But our Excursion has, I fear, lasted too long, and therefore I shall presently re-enter into the way, and proceed to set down some Trials about Cold.

EXPER. VIII.

IN the first Experiment we obferved, that upon the pouring of water upon Sal Armoniac there enfued an intense degree of Cold, and we have elsewhere recited, that the like effect was produc'd by putting, instead of common water, Oyl of Vitriol to Sal Armoniac; but now, to thew further, what influence Motion and Texture may have upon such Trials, it may not be amis to adde the following Experiment: To twelve ounces of Sal Armoniac we put by degrees an equal weight of water, and whilst the Liquor was dissolving the Salt, and by that action producing a great Coldness, we warily pour'd in twelve ounces also of good Oyl of Vitriol; of which new mixture the event was, that a notable degree of Heat was quickly produced in the Glass wherein the Ingredients were confounded, as unlikely as it seemed, that, whereas each each of the Bethanical Dzigine,&c. each of the two Liquors is wont with Sal Armoniac to produce an intense Cold, both of them acting on it together should produce the contrary Quality. But the reason I had to expect the success, I met with, was this, that 'twas probable the Heat arising from the mixture of the two Liquors would overpower the Coldness produceable by the operation of either, or both, of them upon the Salt.

FINIS.





EXPER. IX.

IN most of the Experiments that we have hitherto proposed, Cold is wont to be regularly produced in a Mechanical way; but I shall now adde, that in some sort of Trials I found that the Event was varied by unobserved Circumstances; so that sometimes manifest Coldness would be produced by mixing two Bodies together, which at another time would upon their Congress disclose a manifest Heat, and sometimes again, though more rarely, would have but a very faint and remiss degree of either.

Of this fort of Experiments, whose Events I could not confidently undertake for, I found to be, the dissolution of Salt of Tartar in Spirit of Vinegar, and of some other Salts, that were not acid, in the same Menstruum, and even Spirit of Verdigrease (made per se) though a more potent

potent Menstruum than common Spirit of Vinegar, would not constantly produce near such a heat at the beginning of its operation, as the greatness of the seeming Effervescence, then excited, would make one expect, as may appear by the following Observation transcrib'd verbatim out of one of my Adversaria.

[Into eight ounces of Spirit of Verdigrease (into which we had put a while before a standard-Thermoscope to acquire the like temper with the Liquor) we put in a wide-mouthed Glass two ounces of Salt of Tartar, as fast as we durst for fear of ma-king the matter boil over; and though there were a great commotion excited by the action and reaction of the Ingredients, which was attended with a copious froth and a histing noise; yet 'twas a pretty while e're the Glass was sensibly warm on the outside; but by that time the falt was all diffolv'd, the Liquor in the Thermoscope appear'd to be impell'd

And yet, if my memory do not much deceive me, I have found, that by mixing Salt of Tartar with another Salt, the Texture of the fixt Alkali was so alter'd, that upon the affusion of spirit of Verdigrease, (made without spirit of Vinegar and spirit of Wine,) though there ensued a great consider with noise and bubbles, yet, instead of an Incalescence, a considerable degree of Coldness was produced.

EXPER. X.

Trials will furnish us with more Instances to shew how the Production of Cold may in some cases be effected, varied, or hinder'd by Mechanical Circumstances that are easily and usually overlook'd. I remember, on this occasion, that though

in the Experiment above recited we observ'd, that Oyl of Vitriol and water being first shaken together; the volatil falt of Sal Armoniac being afterwards put to them, produced a sensible Coldness; yet I found, that if a little Oyl of Vitriol and of the volatile Salt were first put together, though foon after a confiderable proportion of water were added, there would be produc'd not a Coldness, but a manifest degree of Heat, which would impell up the liquor in the Thermoscope to the Height of some inches. And I remember too, that though Salt of Tartar will, as we shall see e're long, grow hot in the water, yet having distill'd some Salt of Tartar and Cinaber in a strong fire, and put the whole Caput mor: tuum into distill'd or Rain-water, it made indeed a hissing there as if it had been Quick-lime, but produced no Heat, that I could by feeling perceive. I shall adde, that not onely, as we have feen already, some unheeded Circumstances may promote

or hinder the artificial Production of Cold by parcicular Agents, but, which will feem more strange, some unobserv'd, and perhaps hardly ob; servable, Indisposition in the Patient may promote or hinder the effects of the grand and Catholick Efficients of Cold, whatever those be. This sufpicion I represent as a thing that further experience may possibly countenance, because I have sometimes found, that the degree of the Operation of Cold has been much varied by latent Circumstances, some bodies being more wrought upon, and others less, than was upon very probable grounds expected. particularly I remember, that though Oyl of Vitriol be one of the firiest liquors that is yet known, and does perform some of the Operations of fire it self, (as we shall elsewhere have occasion to shew) and will thaw Ice sooner than Spirit of Wine or any other liquor, as I have tried; yet. having put about a pound or more, by our estimate, of choice rectified

34 Of the Wethanical Dzigine Oyl of Vitriol into a strong Glass-Vial proportionable to it, we found, that, except a little that was fluid at the top, it was all congeal'd or coagulated into a mass like Ice, though the Glass stood in a Laboratory where a fire was constantly kept not far from it, and where Oyl of Vi-triol very seldom or never has before or fince been observ'd to congeal or coagulate so much as in part. And the odness of our Phanomenon was increas'd by this Circumstance, that the Mass continued folid a good while after the weather was grown too mild to have such Operations upon Liquors far less indispos'd to lose their fluidity by Cold, than even common Oyl of Vitriol is. On the other fide I remember, that about two years ago, I expos'd fome Oyl of sweet Almonds hermetically seal'd up in a Glass-bubble, to ob-ferve what Condensation an intense cold could make of it, (for though Cold expands water, it condenses common oyl;) but the next day ! found

found to my wonder, that not onely the oyl remain'd unfrozen by the sharp frost it had been expos'd to, but that it had not its transparency troubled, though 'tis known, that oyl will be brought to concrete and turn opacous by a far less degree of Cold than is requisite to freeze water; notwithstanding which this liquor, which was lodged in a glass so thin, that 'twas blown at the flame of a Lamp, continued fluid and diaphanous in very frosty weather, so long till I lost the expectation of feeing it congeal'd or concreted. And this brings into my mind, that though Camphire be, as I formerly noted, reckon'd by many potentially cold, yet we kept some oyl of it, of our making, wherein the whole body of the Camphire remain'd, being onely by some Nitrous Spirits reduc'd to the form of an Oyl; we kept it, I say, in such intense degrees of Cold, that would have easily frozen water, without finding it to lose its Transparency

Parency or its Fluidity.

And here I shall put an end to the first Section, (containing our Notes about Cold) the design of which may be not a little promoted by comparing with them the beginning of the ensuing Section. For if it be true, that (as we there shew) the nature of Heat confifts either onely or chiefly in the local motion of the fmall parts of a body Mechanically modified by certain conditions , of which the principal is the vehemency of the various agitations of those insensible parts; and if it be also true, as Experience witnesses it to be, that, when the minute parts of a body are in or arrive at such a state, that they are more flowly or faintly agitated than those of our fingers or other organs of feeling, we judge them cold: These two things laid together feem plainly enough to argue, that a Privation or Negation of that Local Motion that is requisite to constitute Heat, may suffice for the denominating a body Cold, as Coldness

ness is a quality of the Object, (which as 'tis perceiv'd by the mind, is also an affection of the Sentient:) And therefore an Imminution of such a degree of former motion as is necessary to make a body Hot as to sense, and which is sufficient to the Production of fensible Coldness, may be Mechanically made, fince Slowness as well as Swiftness being a Mode of Local motion is a Mechanical thing: And though its effect, which is Coldness, seem a Privation or Negation; yet the Cause of it may be a positive Agent acting Mechanically, by clogging the Agile Calorific Particles, or deadning their motion, or perverting their determination, or by some other intelligible way bringing them to a state of Coldness as to sense: I say Coldness as to sense; because as 'tis a Tactile Quality, in the popular acception of it, 'tis relative to our Organs of Feeling; as we see that the same luke warm water will appear hot and cold to the same mans hands, if, when

when both are plung'd into it, one of them shall have been newly held to the fire, and the other be benum. med with frost. And indeed the custom of speaking has introduced an ambiguity into the word Cold, which often occasions mistakes, not eafily without much attention and fometimes circumlocution also to be avoided; fince usually by Cold is meant that which immediately affects the fenfory of him that pronounces a body Cold, whereas sometimes 'tis taken in a more general notion for such a Negation or Imminution of motion, as though it operates not perceivably on our fenfes, does yet upon other bodies; and fometimes also it is taken (which is perhaps the more Philosophical sense) for a perception, made in and by the mind, of the alteration produced in the Corporeal Organs by the operation of that, whatever it be, on whose account a body is found to be cold.

of Heat and Cold.

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But the Discussion of these Points is here purposely omitted, as for other Reasons, so principally because they may be found expressly handled in a fitter place.

SECT.

SECT. II.

Of the Mechanicall Origine or Production of HEAT.

A stances I had to offer of the Production of Cold, it remains that I also propose some Experiments of Heat, which Quality will appear the more likely to be Mechanically producible, if we consider the nature of it, which seems to consist mainly, if not onely, in that Mechanical affection of matter we call Local motion mechanically modified, which modification, as far as I have observed, is made up of three Conditions.

The first of these is, that the agitation of the parts be vehement, by which degree or rapidness, the motion proper to bodies that are hot distindistinguishes them from bodies that are barely fluid. For these, as such, require not near so brisk an agitation, as is wont to be necessary to make bodies deserve the name of hot. Thus we fee that the particles of water in its natural (orufual) state, move so calmly, that we do not feel it at all warm, though it could not be a liquor unless they were in a restless motion; but when water comes to be actually hot, the motion does manifestly and proportionably appear more vehement, fince it does not onely briskly strike our organs of feeling, but ordinarily produces store of very small bubbles, and will melt butter or coagulated oyl, cast upon it, and will afford vapours, that, by the agitation they suffer, will be made to ascend into the air. And if the degree of Heat be fuch as to make the water boil, then the agitation becomes much more manifest by the confus'd motions, and waves, and noise, and bubbles, that are excited, and by other obvious

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obvious effects and Phænomena of the vehement and tumultuous motion, which is able to throw up visibly into the air great store of Corpuscles, in the form of vapours or smoak. Thus in a heated Iron the vehement agitation of the parts may be easily inferr'd from the motion and histing noise it imparts to drops of water or spittle that fall upon it. For it makes them his and boil, and quickly forces their particles to quit the form of a liquor, and flye into the air in the form of steams. And lastly, Fire, which is the hottest body we know, confifts of parts so vehemently agitated, that they perpetually and swiftly flye abroad in swarms, and distipate or shatter all the combustible bodies they meet with in their way; fire making so fierce a dissolution, and great a dispersion of its own fuel, that we may fee whole piles of solid wood (weighing perhaps many hundred pounds) so distipated in very few hours into flame and smoak, that oftentimes

tentimes there will not be one pound of Ashes remaining. And this is the first Condition required to Heat.

The second is this, that the determinations be very various, some particles moving towards the right, fome to the left, hand, some directly upwards, some downwards, and some obliquely, &c. This variety of determinations appears to be in hot bodies both by some of the Instances newly mention'd, and especially that of flame, which is a body; and by the diffusion that metals acquire, when they are melted, and by the operations of Heat that are exercis'd by hot bodies upon others, in what posture or scituation soever the body to be heated be applied to them. As a thoroughly ignited Coal will appear every way red, and will melt wax, and kindle brimstone, whether the body be apply'd to the upper or to the lower, or to any other part of the burning Coal. And congruously to this Notion, though

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air and water be mov'd never fo vehemently as in high Winds and Cataracts, yet we are not to expect that they should be manifestly hot, because the vehemency belongs to the progressive motion of the whole body; notwithstanding which, the parts it confifts of may not be near fo much quickned in their motions made according to other determinations, as to become sensibly hot. And this Consideration may keep it from seeming strange, that in some cases, where the whole body, though rapidly moved, tends but one way, tis not by that swift motion perceived to be made Hot.

Nay, though the agitation be very various as well as vehement, there is yet a third Condition required to make it Calorific, namely, that the agitated particles, or at least the greatest number of them, be so minute as to be singly insensible. For though a heap of sand or dust it self were vehemently and consusedly agitated by a whirlwind, the bulk of the

the grains or Corpuscles, would keep their agitation from being properly Heat, though by their numerous strokes upon a man's face, and the brisk commotion of the spirits and other small particles that may thence ensue, they may perchance occasion the production of that Quality.

If some attention be employ'd in considering the formerly proposed Notion of the nature of Heat, it may not be difficult to discern, that the Mechanical production of it may be divers ways effected. For, excepting in some few Anomalous cases, (wherein the regular course of things happens to be over-rul'd,) by whatever ways the Insensible parts of a body are put into a very confus'd and vehement agitation , by the fame ways Heat may be introduc'd into that body: agreeably to which Docrine, as there are several Agents and Operations by which this Calorific Motion (if I may so call it) may be excited, so there may be several ways of Mechanically producing Heat,

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air and water be mov'd never fo vehemently as in high Winds and Cataracts, yet we are not to expect that they should be manifestly hot, because the vehemency belongs to the progressive motion of the whole body; notwithstanding which, the parts it confifts of may not be near so much quickned in their motions made according to other determinations, as to become sensibly hot. And this Consideration may keep it from feeming strange, that in some cases, where the whole body, though rapidly moved, tends but one way, tis not by that swift motion perceived to be made Hot.

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Heat, and many Experiments may be reduc'd to almost each of them, chance it self having in the Laboratories of Chymilts afforded diven Phanomena referrable to one or other of those Heads. Many of the more familiar Instances, applicable to our present purpose, have been long fince collected by our justly famous Verulam in his short, but excellent, Paper de forma calidi, wherein (though I do not acquiesce in every thing I meet with there) he feem to have been, at least among the Moderns, the Person that has first hand led the Doctrine of Heat like an Experimentall Philosopher. I shall therefore decline accumulating multitude of Instances of the Production of Heat, and I shall also for bear to infift on fuch known things, as the Incalescence observable upon the pouring either of Oyl of Vitrio upon Salt of Tartar, (in the making of Tartarum Vitriolatum) or of Aqua fortis upon Silver or Quickfilver, (in the dissolution of these Metals) but Mall

shall rather chuse to mention some few Instances not so notorious as the former, but not unfit by their variety to exemplifie several of the differing

ways of exciting Heat.

And yet I shall not decline the mention of the most obvious and familiar Instance of all, namely the Heat observed in Quick-lime upon the affusion of cold water, because among learned men, and especially Peripateticks, I find causes to be afsign'd that are either justly questionable or manifestly erroneous. For as to what is inculcated by the Schools about the Incalescence of a mixture of Quick-lime and water by vertue of a supposed antiperistasis or Invigoration of the internal Heat of the Lime by its being invironed by cold water, I have ellewhere shewn, that this is but an Imaginary Cause, by delivering upon Experiment (which any man may easily make) that, if instead of cold water the liquor be poured on very hot, the ebullition of the Lime will not be the less;

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oyl of Turpentine, which is a lighter, and is lookt upon as a fubtiler liquor than water, though it be poured quite cold on Quick-lime, will not, that I have observed, grow so

much as sensibly hot with it.

And now I have mentioned the Incalescence of Lime, which, though an abvious Phenomenon, has exercifed the wits of divers Philosophers and Chymists, I will adde two or three Observations in order to an Inquiry that may be some other time made into the genuine Causes of it; which are not so easie to be found as many learned men may at first fight imagine. The acute Helmont indeed and his followers have ingeniously enough attempted to derive the Heat under confideration from the conflict of some Alcalizate and Acid salts, that are to be found in Quick-lime, and are dissolved, and so fet at liber ty to fight with one another by the water that flakes the Lime. But though we have some manifest marks

of an Alcalizate Salt in Lime, yet that it contains also an Acid Salt, has not, that I remember, been proved; and if the emerging of Heat be a sufficient reason to prove a latent acid Salt in Lime, I know not, why I may not inferr, that the like Salt lies conceal'd in other bodies, which the Chymists take to be of the purest or meerest fort of Alcalys.

For I have purposely EXPER. 1.

tried, that by putting a

pretty quantity of dry Salt of Tartar in the palm of my hand, and wetting it well in cold water, there has been a very sensible Heat produced in the mixture; and when I have made the trial with a more considerable quantity of salt and water in a Viol, the heat proved troublesomely intense, and continued to be at least sensible a good while after.

This Experiment seems to favour the opinion, that the Heat produced in Lime whilst 'cis quenching, proceeds from the Empyreuma, as the Chymists call it, or impression left

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by the violent fire, that was employ'd to reduce the stone to Lime. But if by Empyreuma be meant a bare impression made by the fire, 'cwill be more requisite than easie, to declare intelligibly, in what that impression consists, and how it operates to produce such considerable effects. And if the effect be ascribed to swarms of Atomes of fire, that remain adherent to the substance of the Lime, and are set at liberty to flye away by the liquor, which feems to be argued by the flaking of Lime without water, if it be for some time left in the air, whereby the Atomes of fire get opportunity to flye away by little and little: If this, I fay, be alledged, I will not deny but there may be a sense, (which I cannot explicate in few words) wherein the Cooperation of a substantial Effluvium, for so I call it, of the fire, may be admitted in giving an account of our Phanomenon. But the Cause formerly assigned, as 'tis crudely proposed, leaves in my mind

some Scruples. For 'tis not so easie to apprehend, that fuch light and minute bodies as those of fire are supposed, should be so long detained as by this Hypothesis they must be allowed to be, in Quick-lime, kept in well-stopt vessels, from getting out of lo laxe and porous a body as Lime, especially since we see not a great Incalescence or Ebullition enfue upon the pouring of water upon Minium, or Crocus Martis per fe, though they have been calcined by violent and lasting fires, whose Effluviums or Emanations appear to adhere to them by the increase of weight, that Lead, if not also Mars, does manifestly receive from the Operation of the Fire. To which I shall adde, that, whereas one would think that the igneous Atoms should either flye away, or be extinguished by the supervening of water, I know, and elsewhere give account, of an EXPER. II. Experiment, in which

two Liquors, whereof one was fur-D 4 nished nished me by Nature, did by being several times separated and reconjoyned without additament, at each congress produce a sensible Heat.

And an Instance of

EXPER. III. this kind, though not so odd, I pur-

posely sought and found in Salt of Tartar, from which, after it had been once heated by the affusion of water, we abstracted or evaporated the Liquor without violence of fire, till the Salt was again dry; and then putting on water a fecond time, the Tame Salt grew hot again in the Vial, and, if I misremember not, it produced this Incalescence the third time, if pot the fourth; and might probably have done it oftner, if I had had occasion to prosecute the Experiment. Which feems at least to argue, that the great violence of fire is not necessary to impress what paffes for an Empyreum upon all calcined bodies that will heat with water.

And on this occasion I shall venture to adde, that I have sometimes doubted, whether the Incalescence may not much depend upon the particular Disposition of the calcined body, which being deprived of its former moisture, and made more porous by the fire, doth by the help of those igneous Effluviums, for the most part of a saline nature, that are dispersed through it, and adhere to it, acquire such a Texture, that the water impell'd by its own weight, and the pressure of the Atmosphere, is able to get into a multitude of its pores at once, and suddenly dissolve the Igneous and Alcalizate Salt it every where meets with there, and briskly disjoyn the earthy and solid particles, that were blended with them; which being exceeding numerous, though each of them perhaps be very minute, and moves but a very little way, yet their mukitude makes the confused agitation of the whole aggregate of them, and of the particles of the water and falt vehement

52 Of the Wechanical Dzigine ment enough to produce a sensible Heat; especially if we admit, that there is such a change made in the Pores, as occasions a great increase of this agitation, by the ingress and action of some subtile ethereal matter, from which atone Monsieur des Cartes ingeniously attempts to derive the Incalescence of Lime and water, as well as that of metals dissolved in corrofive Liquors; though as to the Phanomena we have been confidering, there seems at least to concur a peculiar disposition of body, wherein Heat is to be produced to do one or both of these two things, namely, to retain good store of the igneous Effluvia, and to be, by their adhesion or some other operation of the fire, reduced to such a Texture of its component Particles, as to be fit to have them easily penetrated, and briskly as well as copiously dissipated, by invading water. And this Conjecture (for I propose it as no other) seems favour'd by divers Phenomena, some whereof I shall

now

now annex. For here it may be observed, that both the dissolved Salt of Tartar lately mentioned, and the artificial Liquor that grows hot with the natural, reacquires that Disposition to Incalescence upon a bare Constipation or closer Texture of the parts from the superfluous moisture they were drowned in before: The Heat that brought them to this Texture having been so gentle, that 'tis no way likely that the igneous Exhalations could themselves produce such a Heat, or at least that they should adhere in such numbers as must be requisite to such an effect, unless the Texture of the Salt of Tartar (or other body) did peculiarly dispose it to detain them; since I have found by Trial, that Sal Armoniac dif- EXPER. IV. folv'd in water, though

boiled up with a brisker fire to a dry falt, would, upon its being again diffolved in water, not produce any Heat, but a very confiderable degree of Cold. I shall adde, that though

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though one would expect a great Cognation between the particles of Fire adhering to Quick-Lime, and those of high rectified Spirit of Wine, which is of so igneous a nature, as to be totally inflammable; yet I have not found, that the affu-fion of Alkaol of Wine upon Quick, Lime, would produce any sensible Incalescence, or any visible diffolution or diffipation of the Lime, as common water would have done though it seemed to be greedily enough soaked in by the lumps of Lime. And I further tried, that, if on this Lime so drenched I poured cold water, there infued no manifell Heat, nor did I so much as find the lump swelled, and thereby broken till some hours after; which seems to argue, that the Texture of the Lime was fuch, as to admit the particles of the Spirit of Wine into some of its pores, which were elther larger or more congruous, with out admitting it into the most no merous ones, whereinto the Liquor mul

must be received, to be able suddenly to dissipate the Corpuscles of Lime into their minuter particles, into which (Corpuscles) it seems that the change that the aqueous particles received by associating with the spirituous ones, made them far less fit to penetrate and move briskly there, than if they had enter'd alone.

I made also an Experiment that seems to savour our Conjecture, by shewing how much the Disposition of Lime to Incalescence may depend upon an idoneous Texture, and the Experiment, as I find it registred in one of my Memorials, is this.

EXPER. V.

Retort as much moderately strong Spirit of Wine as would drench it, and swim a pretty way above it; and then distilling with a gentle

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gentle fire, we drew off some Spirit of Wine much stronger than that which had been put on, and then the Phlegm following it, the fire was increas'd, which brought over a good deal of phlegmatic strengthless Li. quor; by which one would have thought that the Quick-lime had been flaked; but when the remaining matter had been taken out of the Retort, and suffer'd to cool, it appear'd to have a fiery disposition that it had not before. For if any lump of it as big as a Nutmeg or an Almond was cast into the water, it would his as if a coal of fire had been plunzed into the Liquor, which was foon thereby fenfibly heated Nay, having kept divers lumps of this prepared Calx well cover'd from the air for divers weeks, to try whether it would retain this property, I found, as I expected, that the Calx operated after the same manner, if not more powerfully. For sometimes, especially when twas reduced to small pieces, it would upon its

its coming into the water make such a brisk noise, as might almost pass for

a kind of Explosion.]

These Phanomena seem to argue, that the Disposition that Lime has to grow hot with water, depends much on some peculiar Texture, since the aqueous parts, that one would think capable of quenching all or most of the Atomes of Fire that are supposed to adhere to Quick-lime, did not near so much weaken the disposition of it to Incalescence, as the accession of the spirituous Corpuscles and their Contexture, with those of the Lime, increased that igneous Disposition. And that there might intervene such an affociation, seems to me the more probable, not onely because much of the distill'd Liquor was as phlegmatick, as if it had been robb'd of its more active parts, but because I have sometimes had Spirit of Wine come over with Quick-lime not in unobserved steams, but white fumes. To which I shall adde, that, besides that the Taste, and perhaps Odour

Odour of the Spirit of Wine, is oft. en manifestly changed by a wellmade Distillation from Quick-lime; I have sometimes found that Liquor to give the Lime a kind of Alcalizat penetrancy, not to fay fieriness of Taste, that was very brisk and remarkable. But I will not undertake, that every Experimenter, nor I my felf, shall always make trials of this kind with the same success that I had in those above recited, in regard that I have found Quick-limes to differ much, not onely according to the degree of their Calcination, and to their Recentness, but also, and that especially, according to the differing natures of the stones and o ther bodies calcined. Which Observation engages me the more to propose what hath been hitherto de liver'd about Quick-lime, as onely Narratives and a Conjecture; which I now perceive has detain'd us fo long, that I am oblig'd to hasten to the remaining Experiments, and to be the more succinct in delivering them. EX-

EXPER. VI.

Nd it will be convenient to begin with an instance or two of the Production of Heat, wherein there appears not to intervene any thing in the part of the Agent or Patient but Local Motion, and the natural Effects of it. And as to this fort of Experiments, a little attention and reflection may make some familiar Phanamenon apposite to our present purpose. When, for example, a Smith does hastily hammer a Nail or such like piece of iron, the hammer'd metal will grow exceeding hot, and yet there appears not any thing to make it so, save the forcible motion of the hammer which impresses a vehement and variously determin'd agitation of the small parts of the Iron; which being a cold body before, by that superinduc'd commotion of its small parts, becomes in divers senses hot; first in a more

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more lax acceptation of the word in reference to some other bodies, in respect of whom 'twas cold before. and then fenfibly hot; because this newly gain'd agitation surpasses that of the parts of our fingers And in this Instance 'tis not to be overlookt, that oftentimes neither the hammer, by which, nor the anvil, on which a cold piece of Iron is forged, (for all iron does not require precedent ignition to make it obey the hammer) continue cold after the operation is ended; which shews, that the Heat acquir'd by the forged piece of iron was not communicated by the Hammer or Anvil as Heat, but produc'd in it by motion, which was great enough to pu fo small a body as the piece of iron into a strong and confus'd motion of its parts without being able to have the like operation upon fo much great ter masses of metal, as the Hammer and the Anvil; though if the perculsions were often and nimbly renewed, and the Hammer were but small, t his

this also might be heated, (though not so soon nor so much as the iron;) by which one may also take notice, that 'tis not necessary, a body should be it self hot, to be calorific. And now I speak of striking an iron with a Hammer, I am put in mind of an Observation that feems to contradict, but does indeed confirm, our Theory: Namely, that, if a somewhat large nail be driven by a hammer into a plank or piece of wood, it will receive divers strokes on the head before it grow hot; but when 'tis driven to the head, so that it can go no further, a few strokes will suffice to give it a confiderable Heat; for whilft, at every blow of the hammer, the nail enters further and further into the wood, the motion that is produc'd is chiefly progressive, and is of the whole nail tending one way; whereas, when that motion is stopt, then the impulse given by the stroke being unable either to drive the nail further on, or destroy its intireness, must be spent in making a vari62 Of the Wethanical Dzigine

various vehement and intestine commotion of the parts among themselves, and in such an one we formerly observed the nature of Heat to consist.

EXPER. VII.

TN the foregoing Experiment the brisk agitation of the parts of a heated iron was made sensible to the touch; I shall now adde one of the attempts, that I remember I made to render it discoverable to the eye is self. In order to this, and that I might also shew, that not onely sensible but an intense degree of hear may be produc'd in a piece of cold iron by Local Motion, I caus'd a ba of that metal to be nimbly ham mer'd by two or three lusty men ac custom'd to manage that Instrument and these striking with as much force, and as little intermission a they could upon the iron, som brought it to that degree of Heat, that

that not onely 'twas a great deal too hot to be safely touched, but probably would, according to my design, have kindled Gunpowder, if that which I was sain to make use of had been of the best sort: For, to the wonder of the by-standers, the iron kindled the Sulphur of many of the grains of the corns of powder, and made them turn blue, though I do not well remember, that it made any of them go off.

EXPER. VIII.

Besides the effects of manifest and violent Percussions, such as those we have been taking notice of to be made with a hammer, there are among Phanomena obvious enough, some that shew the Producibleness of Heat even in cold iron, by causing an intestine commotion of its parts: For we find, that, if a piece of iron of a convenient shape and bulk be nimbly filed with a large rough File,

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a confiderable degree of Heat will be quickly excited in those parts of the iron where the File passes to and fro, the many prominent parts of the Instrument giving a multitude of strokes or pushes to the parts of the iron that happen to stand in their way, and thereby making them put the neighbouring parts into a brisk and confus'd motion, and so into a state of Heat. Nor can it be well objected, that upon this account the File it felf ought to grow as hot as the iron, which yet it will not do; since, to omit other answers, the whole body of the File being moved to and fro, the same parts, that touch the iron this moment pass off the next, and besides have leasure to cool themselves by communicating their newly received Agitation to the air before they are brought to grate again upon theiron, which, being supposed to be held immoveable, receives almost perpetual shakes in the same place.

We find also, that Attrition, if it be any thing vehement, is wont to produce Heat in the solidest bodies; as when the blade of a Knife being nimbly whetted grows presently hot. And if having taken a brass Nail, and driven it as far as you can to the end of the stick, to keep it fast and gain a handle, you then strongly rub the head to and fro against the floor or a plank of wood, you may quickly find it to have acquired a Heat intense enough to offend, if not burn ones fingers. And I remember, that going once in exceeding hot weather in a Coach, which for certain reafons we caus'd to be driven very fast, the attrition of the Nave of the Wheel against the Axel-tree was so vehement as oblig'd us to light out of the Coach to feek for water, to cool the over-chafed parts, and stop the growing mischief the excessive Heat had begun to do.

The vulgar Experiment of strikeing fire with a Flint and Steel sufficiently declares, what a heat in a trice may

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may be produc'd in cold bodies by Percussion, or Collision; the later of which seems but mutual Percussion.

But Instances of the same sort with the rest mention'd in this VI. Experiment being obvious enough. I shall forbear to multiply and inside on them.

EXPER. IX.

For the sake of those that think the Attrition of contiguous air is necessary to the Production of manifest Heat, I thought a mong other things of the following Experiment, and made Trial of it.

We took some hard black Pitch, and having in a Bason, Poringer, or some such Vessel, placed it a convenient distance under water, we call on it with a good Burning-glass the Sun-beams in such a manner, that notwithstanding the Refraction that they suffer d in the passage through

the interposed water, the Focus sell upon the Pitch, wherein it would produce sometimes bubbles, sometimes smoak, and quickly communicated a degree of Heat capable to make Pitch melt, if not also to boil.

EXPER. X.

Hough the first and second Experiments of Section I. shew, that a considerable degree of Cold is produc'd by the dissolution of Sal Armoniac in common water; yet by an additament, though but single, the Texture of it may be so alter'd, that, instead of Cold, a notable degree of Heat will be produced, if it be dissolved in that Liquor. For the manifestation of which we devis'd the sollowing Experiment.

We took Quick-lime, and slaked it in common cold water, that all the igneous or other particles, to which its power of heating that Li-

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68 Df the Bechanical Dzigine quor is ascrib'd, might be extracted and imbib'd, and so the Calx freed from them; then on the remaining powder fresh water was often pour. ed, that all adhering reliques of Salt might be wash'd off. After this, the thus dulcified calx, being again well dried, was mingled with an equal weight of powder'd Sal Armoniac, and having with a strong fire melted the mass, the mixture was poured out; and being afterwards beaten to powder, having given it a competent time to grow cold, we put two or three ounces of it into a widemouthed Glass, and pouring water upon it, within about a minute of an hour the mixture grew warm, and quickly attain'd so intense a Heat, that I could not hold the Glass in my hand. And though this Heat did not long last at the same height, it continued to be very sensible for a confiderable time after.

EXPER. XI.

O confirm this Experiment by a notable variation; we took finely powder'd Sal Armoniac, and filings or scales of Steel, and when they were very diligently mixt (for that Circumstance ought to be observ'd) we caus'd them to be gradually fublim'd in a glass vessel, giving a smart fire towards the latter end. By this Operation so little of the mixture ascended, that, as we defired, far the greatest part of the Sal Armoniac staid at the bottom with the metal; then taking out the Caput mortuum, I gave it time throughly to cool, but in a Glass well stopt, that it might not imbibe the moisture of the Air, (as it is very apt to do.) And lastly, though the Filings of Steel, as well as the Sal Armoniac, were bodies actually cold, and so might be thought likely to increase, not check,

70 Di the Wechanital Dzigine check, the coldness wont to be produced in water by that Salt; ver putting the mixture into common water, there ensued, as we expected, an intense degree of Heat, And I remember, that having sublim'd the forementioned Salt in distinct Vessels, with the Filings of Steel, and with Filings of Copper, and for curiofities fake kept one of the Caput mortuums (for I canno certainly call to mind which of the two it was,) divers moneths, (if! mistake not, eight or nine,) we a length took it out of the Vessel wherein it had been kept carefully stopt, and, upon trial, were not de ceiv'd in having expected, that all that while the disposition to give cold water a notable degree of Heat was preserved in it.

EXPER. XII.

TF Experiments were made after the above recited manner with Sal Armoniac and other mineral bodies than Iron and Copper, 'cis not improbable, that some of the emerging Phanomena would be found to confirm what has been faid of the Interest of Texture, (and some few other Mechanical Affections) in the Production of Heat and Cold. Which Conjecture is somewhat favoured by the following Trial. Three ounces of Antimony, and an equal weight of Sal Armoniac being diligently powder'd and mixt, were by degrees of fire sublimed in a Glass-vessel, by which Operation we obtain'd three differing Substances, which we caused to be separately powder'd, when they were taken out of the Subliming Glass, lest the air or time should make any change in them; and having before put the ball of a good

72 Df the Wechanical Dzigine good seal'd Weather-glass for a while into water, that the Spirit of Wine might be brought to the temper of the external Liquor, we put on a convenient quantity of the powder'd Caput mortuum, which a. mounted to two ounces, and seemed to be little other than Antimony, which accordingly did scarce sensbly raise the Spirit of Wine in the Thermoscope, though that were a tender one. Then laying aside that water, and putting the Instrument into fresh, of the same temper, we put to it a very yellow Sublimate, that ascended higher than the other parts, and seemed to consist of the more sulphureous flowers of the Antimony, with a mixture of the more volatile parts of the Sal Armoniac. And this Substance made the tinded Spirit in the Thermoscope defcend very flowly about a quarter of an inch; but when the Instrument was put into fresh water of the same temper, and we had put in some of the powder of the lower fort of Sublimate,

limate, which was dark coloured, though both the Antimony and Sal Armoniac, it consisted of, had been long exposed to the action of a Subliming Heat; yet the water was thereby speedily and notably cooled, insomuch, that the Spirit of Wine in the Weather-glass hastily descended, and continued to sink, till by our guess it had fallen not much short of three inches. Of these Phanomena the Etiology, as fome Moderns call the Theory, which proposes the Causes of things, is more easie to be found by a little confideration, than to be made out in few words.

We made also an Experiment like that above recited, by subliming three ounces a piece of Minium and Sal Armoniac; in which Trial we found, that though in the Caput mortuum, the Salt had notably wrought upon the Calx of Lead, and was in part associated with it, as appear'd by the whiteness of the said Caput mortuum, by its sweetish Taste, and by

74 Df the Wechanical Dzigine by the weight (which exceeded four drams that of all the Minium;) yet a convenient quantity of this pow-der'd mixture being put into water, wherein the former Weather-glass had been kept a while, the tinded Spirit of Wine was not manifeltly either raised or deprest. And when in another Glass we prosecuted the Trial with the Sal Armoniac that had been sublimed from the Mini. um, it did indeed make the Spirit of Wine descend, but scarce a quarter so much as it had been made to fall by the lately mention'd Sublimate of Sal Armoniac and Antimony.

EXPER. XIII.

Is known that many learned men, besides several Chymical Writers, ascribe the Incalescences, that are met with in the dissolution of Metals, to a conflict arifing from a certain Antipathy or Hostility, which they suppose between the conflicting bodies, and particularly between the Acid Salt of the one, and the Alcalizate Salt, whether fixt or volatile, of the other. But fince this Doctrine supposes a hatred between Inanimate bodies, in which 'tis hard to conceive, how there can be any true passions, and does not intelligibly declare, by what means their suppos'd Hostility produces Heat; 'tis not likely, that, for these and some other Reasons, Inquisitive Naturalists will easily acquiesce in it. And on the other side it may be consider'd, whether it be not more probable, that Heats, suddenly produ76 Df the Wechanical Dzigine

ced in mixtures, proceed either from a very quick and copious diffusion of the parts of one body through those of another, whereby both are confusedly tumbled and put into a calorific motion; or from this, that the parts of the dissolved body come to be every way in great numbers violently scatter door from the fierce and confused shocks or justlings of the Corpufcles of the conflicting bodies or masses which may be suppos'd to have the motions of their parts di feringly modified according to the respective Natures: Or from this that by the plentiful ingress of the Corpufcles of the one into the most commensurate parts of the ther, the motion of some etheris matter that was wont before swift to permeate the distinct bodies comes to be check'd and disturbed and forced to either brandish or while about the parts in a confus'd man ner, till it have settled it self a free passage through the new mixture almost as the Light does thorow di vell

vers troubled liquors and vitrified bodies, which at length it makes transparent. But without here engaging in a solemn examination of the Hypothesis of Alcali and Acidum, and without determining whether any one, or more of the newly mention'd Mechanical Causes, or whether some other, that I have not yet named, is to be entitled to the effect; it will not be impertinent to propose divers Instances of the Production of Heat by the Operation of one Agent, Oyl of Vitriol, that it may be consider'd whether it be likely, that this fingle Agent should upon the score of Antipathy, or that of its being an Acid Menstruum, be able to produce an intense Heat in many bodies of so differing natures as are some of those that we shall have occasion to name. And now I proceed to the Experiments themfelves.

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78 Of the Bethanical Dzigine

Take some ounces of strong Oyl of Vitriol, and shaking it with three or four times its weight of common water, though both the liquors were cold when they were put together, yet their mixture will in a trice grow intensely hot, and continue confe derably fo for a good while. In this case it cannot probably be pretend ed by the Chymists, that the Hea arises from the conflict of the Acid and Alcalizate Salts abounding inth two liquors, fince the common we ter is supposed an elementary bod devoid of all lalts; and at least, being an insipid liquor, 'twill scarceb thought to have Alcali enough produce by its Reaction so intense Heat. That the Heat emergent w on such a mixture may be very great when the Quantities of the mingle liquors are confiderably so, may easily concluded from one of Memorials, wherein I find that a more than two ounces of Oyl Vitriol being poured (but not all! once) into four ounces onely of d fille

stilled Rain-water, made and kept it manifestly warm for a pretty deal above an hour, and during no small part of that time, kept it so hot, that twas troublesome to be handled.

EXPER. XIV.

He former Experiment brings into my mind one that I mention without teaching it in the Hiftory of Cold, and it appear'd very furprizing to those that knew not the ground of it. For having fometimes merrily propos'd to heat cold liquors with Ice, the undertaking feem'd extravagant if not impossible, but was eafily perform'd by taking out of a bason of cold water, wherein divers fragments of Ice were swimming, one or two pieces that I perceived were well drenched with the liquor, and immersing them suddealy into a wide mouth'd Glass wherein strong Oyl of Vitriol had been

80 Df the Wechanical Dzigine

been put; for this Menstruum, presently mingling with the water that
adher'd to the ice, produc'd in it a
brisk heat, and that sometimes
with a manifest smoke, which nimbly dissolved the contiguous part
of Ice, and those the next, and so
the whole Ice being speedily reduced to water, and the corrosive
Menstruum being by two or three
shakes well dispersed through it,
and mingled with it, the whole mixture would grow in a trice so hos,
that sometimes the Vial that contain'd it, was not to be endured in
ones hand.

EXPER. XV.

TOtwithstanding the vast difference betwixt common water and high rectified Spirit of Wine, whereof men generally take the former for the most contrary body to fire, and whereof the Chymists take the later to be but a kind of liquid Sulphur, fince it may presently be all reduc'd into flame; yet, as I expected, I found upon trial, that Oyl of Vitriol being mingled with pure Spirit of Wine, would as well grow hot, as with common water. Nor does this Experiment always require great quantities of the liquors. For when I took but one ounce of strong Oyl of Vitriol, though I put to it less than half an ounce of choice Spirit of Wine, yet those two being lightly shaken together, did in a trice conceive so brisk a Heat, that they almost fill'd the vial with fumes, and made it so hot, thar I had una-F 4 wares

82 Df the Dechanical Dzigine wares like to have burnt my hand with it before I could lay it a side.

I made the like Trial with the same Corrosive Menstruum, and common Aqua vitae bought at a Strong-water-shop, by the mixtum of which Liquors, Heat was produc'd in the Vial that I could not well endure.

The like success I had in an Experiment wherein Oyl of Vitro was mixt with common Brandy save that in this the Heat produce seem'd not so intense as in the sormer Trial, which it self affords not so sierce a Heat as that which was made with rectified Spirit of Wine.

EXPER. XVI.

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"Hose Chymists, who conceive that all the Incalescencies of bodies upon their being mixt, proceed from their antipathy or hostility, will not perhaps expect, that the parts of the same body, (either numerically, or in Specie, as the Schools phrase it,) should, and that without manifest conflict, grow very hot together. And yet having for trials Take put two ounces of Colcothar fo strongly calcin'd, that it was burnt almost to blackness, into a Retort, we poured upon it two ounces of strong Oyl of English Vitriol, and found, that after about a minute of an hour they began to grow so hot, that I could not endure to hold my hand to the bottom of the Vessel, to which the mixture gave a heat, that continued sensible on the outside for between twenty and thirty minutes.

EXPER. XVII.

Hough I have not observ'd 4 ny Liquor to equal Oyl of Vitriol in the number of Liquon with which it will grow hot 3 yetl have not met with any Liquor wherewith it came to a greater la calescence than it frequently enough did with common Oyl of Turpen. tine. For when we caused diver ounces of each to be well shake together in a strong vessel, fasten'd to prevent mischief, to the end of pole or staff; the Ebullition was great and fierce enough to be not undefervedly admired by the Spectators. And this brings into my mind a pleasant adventure afforded by these Liquors, of each of which, having for the Production of Heat and other purposes, caus'd a good bottle full to be put up with other things into a box, and fent down into the Countrey with a great charge, that

that care should be had of the Glasses; the Wagon, in which the box was carried, happen'd by a great jolt, that had almost overturn'd it, to be so rudely shaken, that these Glasses were both broken, and the Liquors, mingling in the box, made such a noise and stink, and sent forth such quantities of smoke by the vents, which the sumes had open'd to themselves, that the Passengers with great outcries and much haste threw themselves out of the Wagon, for fear of being burnt in it.

The Trials we made with Oyl of Turpentine, when strong Spirit of Nitre was substituted in the stead of Oyl of Vitriol, belong not to this

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EXPER. XVIII.

OUt though Petroleum, especially When rectified, be, as I have elsewhere noted; a most subtile Li quor, and the lightest I have yet had occasion to try; yet to shew you how much the Incalescence of Li quors may depend upon their Tex ture, I shall adde, that having min by degrees one ounce of rectified Petroleum, with an equal weight of strong Oyl of Vitriol, the forme Liquor seemed to work upon the Surface of this last named almost like a Menstruum, upon a metal, innume rous and small bubbles continually ascending for a while into the Oleun Petre, which had its colour manifelt ly alter'd and deepen'd by the ope ration of the spirituous parts. But by all the action and re-action of these Liquors, there was produced no fuch imoaking and boiling, or intense heat, as if Oyl of Turper

of Vitriol; the change which was produc'd as to Qualities being but a kind of Tepidness discoverable by the Touch.

Almost the like success we had in the Conjunction of Petroleum, and Spirit of Nitre, a more sull account whereof may be elsewhere met

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In this and the late Trials I did not care to make use of Spirit of Salt, because, at least, if it be but ordinarily strong, I found its operation on the Liquors above mention'd inconsiderable, (and sometimes perhaps scarce sensible) in comparison of those of Oyl of Vitriol, and in some cases of dephlegm'd Spirit of Nitre.

EXPER. XIX.

Xperienced Chymists will easily believe, that 'twere not diff. cult to multiply Instances of Hear producible by Oyl of Vitriol upon solid bodies, especially Mineral ones. For 'tis known, that in the usual preparation of Vitriolum Martis, there is a great effervescence excited upon the affusion of the Oyl of Vitriol upon Filings of Steel, espe cially if they be well drench'd in common water. And it will scarce be doubted, but that, as Oyl of Vitriol will (at least partly) dissolve a great many both calcin'd and testaceous bodies, as I have try'd with Lime, Oyster-shells, &c. so it will, during the diffolution, grow fensibly, if not intenfely hot with them, as I found it to do both with those newly named, and others, as Chalk, Lapis Calaminaris, &c. with the last of which, if the Liquor be strong, it will heat exceedingly.

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EXPER. XX.

7Herefore I will rather take notice of its Operation upon Vegetables, as bodies which corrosive Menstruums have scarce been thought fit to dissolve and grow hot with. To omit then Cherries, and divers Fruits abounding in watery juices, with which, perhaps on that very account, Oyl of Vitriol will grow hot; I shall here take notice, that for trial sake, having mixt a convenient quantity of that Liquor with Raisins of the Sun beaten in a Mortar, the Raisins grew so hot, that, if I misremember not, the Glass that contain'd it had almost burnt my hand.

These kind of Heats may be also produc'd by the mixture of Oyl of Vitriol with divers other Vegetable Substances; but, as far as I have observed, scarce so eminently with any dry body, as with the crumbs of

white

white bread, (or even of brown with a little of which we have some times produced a surprising degree of Heat with strong or well-dephlegm'd Oyl of Vitriol, which is to be supposed to have been employed in the foregoing Experiments, and all others mention'd to be made by the help of that Menstruum in our Papers about Qualities, unless it be in any particular case otherwise declared.

EXPER. XXI.

Is as little observed that Corrosive Menstruums are able to work, as such, on the soft parts of dead Animals, as on those of Vege tables, and yet I have more that once produced a notable Heat by mixing Oyl of Vitriol with mince flesh whether roasted or raw.

EXPER. XXII.

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Hough common Sea falt does usually impart some degree, though not an intense one, of Coldness unto common water, during the act of Dissolution; yet some Trials have informed me, that if it were cast into a competent quantity of Oyl of Vitriol, there would for the most part insue an Incalescence, which yet did not appear to succeed fo regularly, as in most of the foregoing Experiments. But that Heat should be produc'd usually, though: not perhaps constantly, by the above-named Menstruum and Salt, feems therefore worthy of our notice, because 'tis known to Chymists, that common Salt is one main Ingredient of the few that make up common factitious Sal Armoniac, that is wont to be fold in the Shops. I have been inform'd, that the excellent Academians of Florence have ob92 Df the Wechanical Dzigine observed, that Oyl of Vitriol would not grow hot but cold by being pu upon Sal Armoniac: Something like which I took notice of in rectified Spirit of Sulphur made per Camp nam, but found the effect much mon confiderable, when, according to the Ingenious Florentine Experi ment, I made the Trial with Oyl Vitriol; which Liquor having ready furnished us with as man Phanomena for our present purpo as could be well expected from a Agent, I shall scarce in this Pan abour Heat make any farther use it, but proceed to some other Exp riments, wherein it does not inte vene.

EXPER. XXIII.

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WE took a good lump of coment shape, and having rub'd or chaf'd it well, we found, as we expected, that by this attrition it grew fenfibly warm; and, That there was an intestine agitation, which you know is Local Motion, made by this attrition, did appear not onely by the newly mention'd Heat, whose nature consists in motion, and by the antecedent pressure, which was fit to put the parts into a disorderly vibration, but also by the sulphureous steams, which twas easie to smell by holding the Sulphur to ones nofe, as foon as it had been rub'd. Experiment, though it may seem trivial in it self, may be worth the consideration of those Chymists. who would derive all the Fire and Heat we meet with in sublunary bodies from Sulphur. For in our case

94 Df the Wechanical Dzigine a mass of Sulphur, before its part were put into a new and brisk mo tion, was fenfibly cold, and as foot as its parts were put into a greate agitation than those of a mans fin gers, it grew fenfibly hot; which argues, that 'twas not by its bar presence, or any emanative action (as the Schools speak) that the Sulphur communicated any Heat my hand; and also that, when 'tw briskly moved, it did impress the Quality, was no more than anoth folid body, though incombustible common Glass, would have done, its parts had been likewise put in an agitation surpassing that of organs of feeling; so that in Experiment, Sulphur it self wash holden, for its actual Heat, tol cal Motion, produced by exten agents in its parts.

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EXPER. XXIV.

7E thought it not amiss to try, whether when Sal Armoniac, that much infrigidates water, and Quick-lime, which is known to heat it, were by the fire exquisitely mingled, the mixture would impart to the Liquor a moderate or an intense degree of either of those Qualities. In profecution of which Inquiry we took equal parts of Sal Armoniac and Quick-lime, which we fluxed together, and putting an ounce, by ghess, of the powder'd mixture into a Vial with a convenient quantity of cold water, we found, that the colliquated mass did, in about a minute, strike so great a heat through the Glass upon my hand, that I was glad to remove it haltily for fear of being scorched.

EXPER. XXV.

WE have given several, and might have given many more, Instances of the Incalescence of Mixtures, wherein both the Ingredients were Liquors, or at least one of them was a fluid body. sometimes Heat may also be produc'd by the mixture of two powders; fince it has been observed in the preparation of the Butter or 0 of Antimony, that, if a sufficien quantity of beaten Sublimate be ve ry well mingled with powder'd Ani mony, the mixture, after it has for competent time (which varies mud according to circumstances, as the weather, vessel, place, &c. wherei the Experiment is made) stood is the air, would fometimes grow m nifestly hot, and now and then & intenfely so, as to fend forth copion and fetid fumes almost as if it would take fire. There is another Expe rimen

riment made by the help of Antimony, and a pulveriz'd body, wherein the mixture, after it had been for divers hours expos'd to the air, visibly afforded us mineral Fumes. And to these I could adde more confiderable, and perhaps scarce credible, Instances of bodies growing hot without Liquors, if Philanthropy did not forbid me. But to return to our Butter of Antimony, it seems not unfit to be enquired, whether there do not unobservedly intervene an aqueous moisture, which (capable of relaxing the falts, and setting them a work) I therefore suspected might be attracted (as men commonly speak) from the air, fince the mixture of the Antimony and the Sublimate is prescribed to be placed in Cellars; and in such we find, that Sublimate, or at least the saline part of it, is resolved per deliquium, (as they call it) which is nothing but a folution made by the watery steams wandering in the Air.

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EXPER. XXVI.

T Have formerly deliver'd some In-I stances of the Incalescence produc'd by water in bodies that are readily diffolv'd in it, as Salt of Tar-tar and Quick-lime. But one would not lightly expect, that meer water should produce an Incalescence in folid bodies that are generally grant ed to be infoluble in it; and areno wont to be, at least without length of time, visibly wrought on by it and yet trial has affured me, that notable Incalescence may be produe'd by common water in flower fine powder of Sulphur, and Filing of Steel or Iron. For when, Summer time, I caus'd to be mingle a good quantity, (as half a pount or rather a pound of each of the la gredients) and caus'd them to be throughly drenched with commo water, in a convenient quantity whereof they were very well fin

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red up and down, and carefully mingled, the mixture would in a short time, perhaps less than an hour, grow fo hot, that the Veffel that contain'd it could not be suffer'd in ones hand; and the Heat was manifested to other Senses than the Touch, by the strong sulphureous stink that invaded the nose, and the thick smoak that ascended out of the mixture, especially when it was stirr'd with a stick or spattle. Whether the fuccess will be the same at all times of the year, I do not know, and somewhat doubt, since I remember not, that I had occasion to try it in other Seasons than in Summer, or in Autumn.

100 Of the Wechanical Deigine

EXPER. XXVII.

N the Instances that Chymistry wont to afford us of the Hen produc'd by the action of Menstru ums upon other bodies, there inter venes some liquor, properly call'd, that wets the hands of those that touch it; and there are diven of the more judicious Chymists, the joyn with the generality of the Na turalists in denying, that Quickfilve, which is indeed a fluid body, but not a mosst and wetting one in re ference to us, will produce Heathr its immediate action on any other body, and particularly on Gold But though I was long inclinable to their opinion, yet I cannot now be of it, feveral Trials having affurd me, that a Mercury, whether afforded by Metals and Minerals, or impregnated by them, may by its preparation be enabled to infinuate it felf nimbly into the body

body of Gold, whether calcin'd or crude, and become manifestly incalescent with it in less than two or three minutes of an hour.

EXPER. XXVIII.

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Cince we know that some natural Salts, and especially Salt-peter, can produce a Coldness in the water they are dissolved in, I thought it might not be impertient to our enquiry into Heat and Cold, and might perhaps also contribute somewhat to the discovery of the Structure of Metals, and the salts that corrode them, if Solutions were made of fome Saliform'd bodies, as Chymists call them, that are made up of metalline and faline parts, and do fo abound with the latter, that the whole Concretions are on their account dissoluble in common water.

102 Df the Bechanical Dzigine

Other Experiments of this for belonging less to this place than to another. I shall here onely for example fake take notice of one that we made upon Quickfilver, which is esteem'd the coldest of Metal For having by distilling from it four times its weight of Oyl of Vitriol reduc'd it to a powder, which on the account of the adhering Salts of the Menstruum that it detain'd, was white and glistering, we put the powder into a wide-mouth'd Glass of water, wherein a seal'd Wer ther-glass had been left before it be gan manifestly to heat the water, a appear'd by the quick and confider able ascent of the tincted Spirit Wine, that continued to rife upon putting in more of the Magistery, which warm event is the more remarkable, because of the observation of Helmont, that the Salt ad hering to the Mercury, corroded in good quantity by Oyl of Vitriol

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The event of the former Trial deserves the more notice, because having after the same manner and with the same Weather-glass made an Experiment with common water, and the powder of Vitriolum Martis, made with Oyl of Vitriol and the Filings of Steel, the tincted Spirit of Wine was not at all impell'd up as before, but rather, after a while, began to subside, and fell, though very flowly, about a quarter of an inch. The like Experiment being tried with powder'd Sublimate in common water, the liquor in the Thermoscope was scarce at all fenfibly either rais'd or deprest, which argued the alteration as to Heat or Cold, to have been either none or very inconsiderable.

Having

104 Df the Wechanical Dzigine

Having given warning at the be ginning of this Section, that in it aimed rather at offering various than numerous Experiments about the Production of Heat, I think what has been already deliver'd may al low me to take leave of this Subject without mentioning divers In stances that I could easily adde, but think it fitter at present to omit For those afforded me by Trials a. bout Antiperistasis belong to a Paper on that Subject. Those that might be offer'd about Potential Heat in humane bodies, would per-chance be thought but unnecessary after what has been said of Potential Coldness; from which an attentive Confiderer may eafily gather, what according to our Doctrine is to be faid of the contrary Quality. And divers Phanomena, which would have been of the most confiderable I could have mentioned of the Production of Heat, fince

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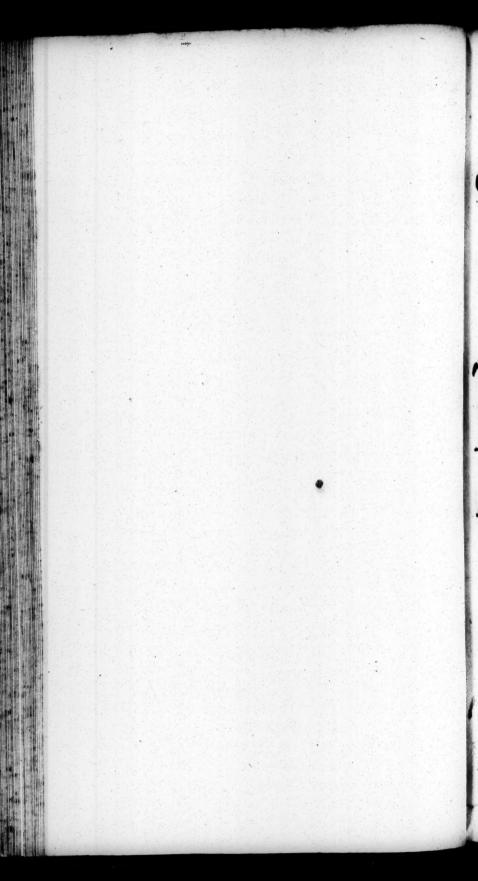
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a. a. fince in them that Quality is the most exalted, I reserve for the Title of Combustibleness and Incombustibility, having already suffer'd this Collection (or rather Chaos) of Particulars about the Production of Heat to swell to too great a bulk.

FINIS.



EXPERIMENTS,

AND

OBSERVATIONS,

About the

Mechanical Production

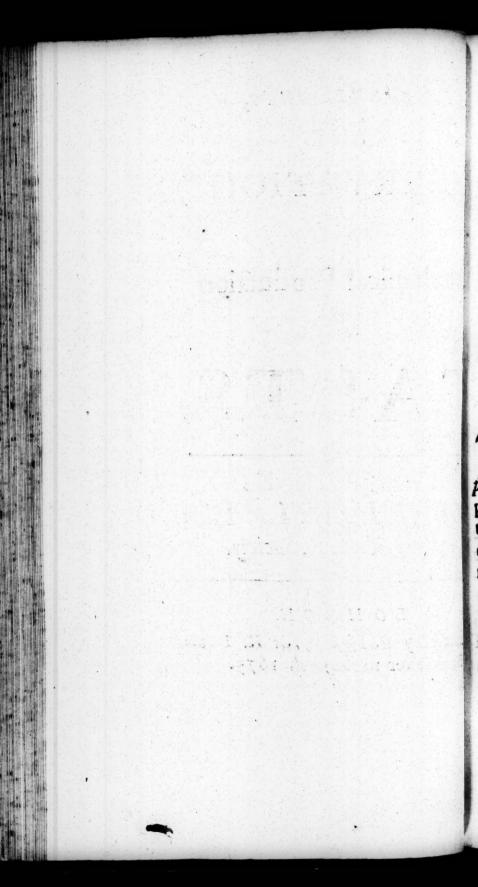
OF

TASTS.

By the Honourable ROBERT BOYLE Esq; Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.



EXPERIMENTS,

AND

OBSERVATIONS,

About the

Mechanical Production

OF

ASTS

O make out the Mechanical Origine or Production of Sapors, as far as is necessary for my present purpose, 'twill be expedient to premise in general, that, according to our notion of Tafts, they may depend upon the bigness, figure and motion of the saportfick corpuscles, considered separately, and as the affections of fingle and very minute particles of matter; or else in a state of conjunction, as two or more.

Az of of these affections, and the particle they belong to, may be combined a associated, either among themselve or with other particles, that we not saporous before. And as the Coalitions and other Association come to be diversified; so the Tall resulting from them, will be alter

or destroyed.

But, to handle these distinctly a fully, were a task not onely tood ficult and long, but improper interplace, where I pretend to deline not Speculations, but matters of fair setting down whereof neverthes to avoid too much consustion, lacontent, where I can doe it read and conveniently, in some of mylals, to couch such references as a best point at those Heads, when the Mechanical explications may derived, and consequently our lactrine confirmed.

By Tast considered as belonging the Object, (under which Notion here treatofit,) I mean that qualior whatever else it be, which bles a body by its operation, to produce in us that sensation, which we feel or perceive when we say we

taft.

That this something, whether you will call it a quality, or whatever else it be that makes or denominates an object saporous, or rather (if I may be allowed a barbarous term) saporisck, may so depend upon the shape, size, motion, and other Mechanical affections of the small parts of the tasted body, and result from the association of two or more of them, not excluding their congruity or incongruity to the organs of Tasting, may be made probable by the following Instances.

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EXPER. I.

To divide a Body, almost insipid, in two Bodies of very strong and very differing Tasts.

IS observed, that Salt-pet refined, and by that purific tion freed from the Sea-falt that wont to be mingled with it, do rather cool the tongue, than make any great faporifick impressions on And though I will not fay, that it as some have thought, an insipid by dy; yet the bitterishness, which see to be its proper taft, is but very fait and languid. And yet this almo infipid body, being distilled by the way of Irflan mation, (which I ell where teach,) or even by the helpa an additament of such clay as ist self a tastless body, will afford a Ni trous spirit, that is extreamly share or corrolive upon the tongue, and will dissolve several Metals them felves, and a fixt salt, that is like Wilt

wise very strongly tasted, but of a tast altogether different from that of the Spirit, that is extreamly sharp or corrosive upon the tongue; and accordingly, this salt will dissolve divers compact bodies that the other will not work on, and will precipitate divers metals and other concretes out of those solutions, that have been made of them by the Spirit.

EXPER. II.

Of two Bodies, the one highly Acid and corrolive, and the other Alkalizat and fiery, to produce a Body almost insipid.

This may be performed by the way I have elsewhere mentioned of composing Salt-peter. For if upon a liquour of fixt Nitre, made per Deliquium, you warily drop good Spirit of Nitre, till it be just enough to satiate the Alkaly, (for if there

be too much or too little, the Experiment may miscarry,) we may by gentle evaporation, and sometime without it, and that in a few minute obtain Crystals, which, being disaster they have been, if it be new full, freed from any adhering particles, (not of their own nature,) where a have upon the tongue neither a share and scarce sensible bitterness that and scarce sensible bitterness that a longs to Salt-peter, if it be pured a peter; for the impure may perhaps frongly relish of the common of that is usually contained in it.

The like production of Salt-pe of we have sometimes made in far me time, and sometimes indeed in and the by substituting, in stead of the far salt of Nitre, the saline parts of go we Pot-ashes, carefully freed by solution and filtration from the earthy of the salt of th

feculent ones.

I have sometimes considered, which there the Phanomena of these two periments may not be explicated a supposing them to arise from the management of the supposing them to arise from the management of the supposing them to arise from the management of the supposing them to arise from the management of the supposing them to arise from the supposing them to arise from the supposing them.

magnitudes and figures of the particles, which the fire, by breaking them, or forcibly rubbing them one against the other, or also against the Corpufcles of the additament, may be presumed to give them; as if, for example, fince we find the larger and best formed Crystals of Nitre to be of a prismatical shape with six sides, we should suppose the corpuscles of Nitre to be little prisms, whose angles and ends are too obtuse or blunt to make vigorous and deep impressions on the tongue; and yet, if these little prisms be by a violent heat split, or otherwise broken, or forcibly made as it were to grind one another, they may come to have parts so much smaller than before, and endowed with such sharp sides and angles, that, being dissolved and agitated by the spittle that usually moistens tongue, their smalness may give them great access to the pores of that organ, and the sharpness of their sides and points may fit them to stab and cut, and perhaps fear the nervous and

and membranous parts of the org of Tast, and that variously, according to the grand diversities, as to shap i and bulk, of the saporifick partice? themselves. And this being grant ! it seemed further conceivable, the when the Alkalizate and Acid par u cles come to be put together in b fluid mixture, wherein they fwe v many of them might, after a multim o of various justlings and occuring fl meet with one another so luckily at opportunely, as to recompose in vo prisms, or convene into other bod ti almost like those that made up fe Crystals of Nitre, before 'twas en co sed to the fire. To illustrate whista we may conceive, that, thought prism of iron may be so shaped, hi it will be wholly unfit to pierce w skin; yet it may be so cut by m verse planes reaching to the opport and bases or ends, as to afford wed n which, by the sharpness of their ges, may be fit both to cleave wo and cut the skin; and these wed being again put together after af quit

quisite manner, may recompose a prism, whose extreams shall be too blunt to be fit for the former use. This may be also illustrated by the breaking of a dry stick circularly cut off at the ends, which though it is unapt, whilst intire and of that bulk, to prick the hand; yet if it be violently broken, the ragged ends of it and the splinters may prove stiff, slender, and sharp enough to pierce and run into the hand : To which divers other such Mechanical Illustrations might be added. But, fince I fear you think, as well as I, the main conjecture may not be worthy any farther prosecution, I shall not infift any longer on it. And because the historical part of these Experiments was for the main delivered by me already in the Essay about the Analysis and Redintegration of Nitre, I shall now proceed to other Trials.

EXPER.

EXPER. III.

Of two Bodies, the one extreamly bitter and the other exceeding Salt, to make an insipid mixture.

O make this Experiment, must very warily pour upo Civitals made of Silver, diffolyed good Aqua fortis or Spirit of Nim strong brine made of common saltu water. For the mixture of these m being dried, and afterwards brough to fusion in a Crucible, and kept competent while in that state, w afford a tough mass, the Chymists Luna Cornea, which you may licki vers times, and scarce judge it other than infipid; nor will it eafily brought to dissolve in much mon piercing Menstruums than our spi tle, as I have elsewhere shewn.

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EXPER. IV.

of two Bodies, the one extreamly sweet, and the other salter than the strongest Brine, to make an insipid mixture.

THE doing of this requires some skill and much wariness in the Experimenter, who, to perform it well, must take a strong solution of Minium, made with an appropriated Menstruum, as good Spirit of Vinegar, or elfe Saccharum Saturni it felf. dissolved in a convenient Vehicle; and then must have great care and caution to put to it, by degrees, a just proportion of strong Spirit of Sal Armoniac, or the like Urinous Spirit, till the whole be precipitated; and if the two former tasts are not sufficiently destroyed in the mixture, it may be dried and fluxed, as was above directed about Luna Cornea.

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EXPER. V.

Of an insipid Body and a sour one. make a Substance more butter the Gall or Aloes.

His is easily performed by folving in strong Spirit of Ni or good Aqua fortis as much pu Silver as the Menstruum will taken for, this solution being filtrated, been often esteemed mose bin h than so much Gall or Worr wood, o any other of those simples that has been famous for that quality: An if the superfluous moisture be abla cted, you may by coagulation obtain Crystals of Luna, that have be judged more strongly bitter than in folution it felf. And that the on pulcles of these Crystals should lear a far more lafting taft of themselve than the above-mentioned birter by dies are wont to doe, wil not fee so marvellous, as I remember som that tried have complained; if w tak

take notice, how deep the particles of these Crystals may pierce into the spungy organs of Tast, since, if one does but touch the pulp or nail of ones singer, (first a little wetted with spittle or otherwise,) with the powder of these Crystals, they will so penetrate the skin or nail, and stick so sast there, that you cannot in a reasonable time wash the stain off of the skin, and much less off of the nail, but it will continue to appear many hours on the former, and many days on the other.

EXPER. VI.

Of an insipid Body and a highly corrosive one, to make a Substance as sweet as sugar.

This is easily done, by putting upon good Minium purified Aqua fortis or Spirit of Nitre, and letting them work upon one another in a gentle heat, till the liquour have dissol-

dissolved its full proportion of the metal. For then, if the ingredient were good, and the operation right performed, the Menstruum would have a sweetness like that of ordinary saccharum saturni. But 'the not for nothing that I intimated, the ingredients should be also pure a good in their kind; for, if the Minimum be adulterated, as often it is, or so spirit of Nitre or Aqua fortish mingled, as it is usual before its purged with Spirit of common had or other unsit ingredients, the or ration may be successless, as I had more than once observed.

EXPER. VII.

Of obtaining without addition from the freetest Bodies, Liquours corrections on the cough to dissolve Metals.

IF Sugar be put into a sufficient of capacious Retort, and warily thilled, (for otherwise it will be a

to break the Vessel) it will afford, en among other things, a copious red Spirit, which, being flowly rectified, will lose its colour, and come over clear. The Caput Mortuum of the Sugar, which I have more than once had of an odd Contexture, may be found either almost or altogether insipid. And though the Spirit will be of a very penetrant tast, yet it will be very far from any kind of sweetness; and though that liquour be thought to be homogeneous, and to be one of the Principles of the analized Sugar, yet (as I have elsewhere shewn) I found it to be a mixture of two Spirits; with the one of which, besides bodies of a less close Texture, I dissolved (even in the cold) crude Copper, as was easie to be seen by the deep and lovely colour of the folution. And to these four Spirits, afforded by Sugar it felf, we have restored a kind of Saccharine sweetness, by compounding them with the particles of so insipid a body as Minium; part of which they

they will in digestion dissolve. I like Spirit to that distilled from Sugar may be obtained from Hong but in regard of its aptness to swe exceedingly, Chymists are not wo to distill it without Sand, Brick, some other additament.

EXPER. VIII.

To divide a Body, bitter in the high degree, into two Substances, the extreamly sour, and the other fectly instpid.

His is easily done by putte fome fine Crystals of Luna in a good Retort, and then distill them in a Sand-furnace, capable giving them so strong a fire, as drive away all the spirits from Silver. For, this remaining behin according to its metalline nature will be insipid, and the spirits, the are driven away from it, will und in the Receiver into an acid and corrosive Menstruum.

EXPER. IX.

To produce variety of Tasts in one insipid Body, by associating it with divers Menstruums.

A 8 this operation may, upon the A account I elsewhere mention, be serviceable to investigate the figures of the particles of dissolved metals and other bodies; so 'tis very fit to manifest, what we would here have it shew, how much Tast may be diversified by, and confequently depend upon, Texture; fince a body that has no tast, may, in conjunction with sapid bodies, give them strong tasts all differing from one another, and each of them from that which the saporous bodies had before. I could propose divers ways of bringing this to trial, there being several insipid bodies, which I have found this way diversifiable. But because I remember not, that I have met with any mineral, that is diffolu-B 2

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dissoluble by near so many saline Menstruums, as Zinke, I look on the as the most fertile Subject to afford Instances to our present purpos For I have found, that it will be dissolved not onely by Aqua forti Aqua Regis, Oil of Vitriol, Spirite Nitre, Spirit of Salt, and other a neral Menstruums, but also by W getable Spirits, as distilled Vinega and by Animal ones too, as Spirit Sal Armoniac; though the one Acid, and the other Urinous. An if the feveral Solutions, which may made of this mineral, by so many fering liquours, be compared, number of their differing tasts w fuffice to make good the Title of Experiment.

EXPER. X.

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To produce variety of Tasts with one Menstruum, by associating it with inspid Bodies.

His Proposition a Mathematician would go near to call the Converse of the foregoing; and as it may ferve as well as that to discover the structure of the minute parts of divers metalline and mineral bodies; so it may not onely as well, but better than that, serve us to illustrate the Corpuscularian Doctrine of Tasts, by shewing us, that a fingle, and, as far as Chymistry teaches us, a simple body, endowed with a peculiar tast, may, by being compounded with others, each of them infipid of it felf, produce a confiderable number of differing tafts. There may be more Instruments than one made use of in this Trial; but of those that are known, and we may easily obtain, the most proper are Spirit of Nitre, B 3 and

and good Aqua fortis: For that with refined silver, will make a so lution bitter as Gall; with Lead 'twill be of a Saccharine sweetness with that part of Tin, which it wi keep dissolved, (for the greatest wont but to corrode and præcipitate it produces a tast very distant from both the former, but not odion; with Copper, it affords an abominable taft; with Mercury and Iron, it fords other kinds of bad Tasts. N are Metals the onely mineral bodie will work upon : For, 'twill diffol Tin-glass, Antimony, Brass; to which I could add Emery, Zinke, and oth bodies whereon I have tried it. which together will make up not spicable number of differing Tab

EXPER. XI.

of two Liquours, the one highly corrosive, and the other very pungent and not pleasant, to compose a Body of a pleasant and Aromatick Tast.

This Experiment, which I elsewhere mention to other purposes, does in some regards better suit our present design, than most of the soregoing; since here the Corrosive Menstruum is neither mortisted by sixt nor urinous Salts, supposed to be of a contrary nature to it; nor yet, as 'twere, tired out nor disarm'd by corroding of metals or other solid bodies. The Experiment being somewhat dangerous to make at first in great, it may suffice for our present turn, to make it in the less quantity, as sollows.

Take one ounce of strong Spirit of Nitre, or of very good Aqua fortis it self, and put to it by little and little, (which caution if you neglect, you B 4 may

may soon repent it,) and another ounce of such rectified Spirit Wine, as, being kindled in a Spoor will flame all away: When thefe the liquours are well mixt, and grow cold again, you may, after some gestion, or, if hast require, without it, distill them totally over together to unite them exquifitly into one quour, in which, if the operation have been well performed, the on rosive particles of the Salts will onely loofe all their cutting acida wherewith they wounded the pale but by their new composition will the Vinous Spirits, the liquour a quires a Vinous tast, that is not on ly not acid or offensive, but ver pleasing, as if it belonged to so new or unknown Spice.

EXPER. XII.

To imitate by Art, and sometimes even in Minerals, the peculiar Tasts of natural Bodies, and even Vegetables.

His is not a fit place to declare, in what fense I do or do not admit of Souls in Vegetables, nor what I allow or deny to the Seminal or Plastick principle ascribed to Plants: But perhaps it will not be erroneous to conceive, that, whatever be the Agent in reference to those Tasts, that are said to be specifick to this or that Plant, that, on whose immediate account it is or becomes of this or that nature, is a complication of Mechanical Affections, as shape, size, &c. in the particles of that matter which is faid to be endowed with such a specifick taft.

Toillustrate this, I thought it expedient, to endeavour to imitate the tast of some Natural bodies by Artisicial cial Compositions or Preparation but found it not easie, beforehan to be assured of the success of success of success. And therefore I shall contemy self here to mention three or so Instances, that, except the sirst, a rather Observations than such Experiments as we are speaking of.

I remember then, that, making fome Trials to alter the sensible Qualities of Smell, Tast, &c. of Oil a Vitriol, and Spirit of Wine, I obtained from them, among other thing that suited with my design, a certain Liquour, which, though at first plans sand, would, at a certain nick of time make one that had it in his most think it had been imbued with Galick.

And this brings into my mind, the a skilful person, famous for making good Sider, coming one day to a vise with me, what he should does heighten the tast of it, and makes keep the longer, complained to me that having, among other trials, points a good Vessel sull of juice of

Apple

Apples a certain proportion of Muftard-feed, with hopes it would make
the Sider more spirituous and pickant, he found, to his wonder and
loss, that, when he came to draw it,
it stank of Garlick so rank, that every body rejected it.

Iremember also, that, by fermenting a certain proportion (for that we found requisite) of femen Dauci with Beer or Ale, the Liquour had a very pleasant Relish of Limon-pills.

But that seems much more considerable, which I shall now add; That, with an infipid Metal and a very corrolive Menstruum, one may compound a tast, that I have several times observed to be so like a Vegetable, that I presume it may deceive many. This may be done by dissolving Gold, without any gross Salt, in the mixture of Aqua fortis and the Spirit of Salt, or even in common Aqua Regis, made by dissolving Sal Armoniac in Aqua fortis. For if the Experiment be happily made, one may obtain either a Solution or a Salt,

Salt, whose austere tast will we much resemble that of Sloes, or unripe Bullace. And this tast, we some little variety, I found in Godissolved without any distilled quour at all; and also, if I much see not, in Gold that by a peculi Menstruum I had volatilized.

The last Instance I shall give the imitation of Tasts, I sound have been, for the main, known some ingenious Ladies. But to make the Experiment succeed very we a due proportion is the principal of cumstance, which is wont to be at lected. I cannot readily call to make that which I sound to succeed by but the Trial may be indisferent well made after such a manner this:

Take a pint or a pound of Male or Canary Sack, (for though Fra and the like Wines may serve turn, yet they are not so proper and put into it a drachm or two good odoriferous Orrice Roots, into thin slices, and let them in the

in the Liquour a convenient time, itill you perceive that they have givenit a desired tast and smell; then keep the thus perfumed Wine exactly stopped in a cool place: According to which way, I remember, that (when I hit on the right proportion of Ingredients, and kept them a due time in infusion) I had many years ago a Wine, which, being coloured with Cochencele, or some such tingeing ingredient, was taken for good Rafberry-Wine, not onely by ordinary persons, but, among others, by a couple of eminent Phylicians, one of whom pretended to an extraordinary criticalness of palate on such occafions; both of them wondering, how at such an unlikely time of the year, as I chose to present them that Liquour among others, I could have Such excellent Rasberry-Wine: Some of which (to add that by the by) I found to preserve the specifick tast two or three years after it was made.

Salt, whose austere tast will we much resemble that of Sloes, or unripe Bullace. And this tast, we some little variety, I found in G

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Production of Casts. 29 in the Liquour a convenient time, ill you perceive that they have given it a desired tast and smell; then

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Salt, whose austere tast will ver much resemble that of Sloes, or a unripe Bullace. And this tast, with some little variety, I found in Gold dissolved without any distilled liquour at all; and also, if I much so get not, in Gold that by a peculi-Menstruum I had volatilized.

The last Instance I shall give the imitation of Tasts, I found have been, for the main, known to some ingenious Ladies. But to make the Experiment succeed very wal, a due proportion is the principal succeeding the cumstance, which is wont to be not lected. I cannot readily call to min that which I found to succeed bethe but the Trial may be indifferent well made after such a manners this:

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A Short

EXCURSION

About some Changes made

OF

TAST

BY

MATURATION,

pertinent, but rather necessary, add a word or two on this occur for their sakes, that think the Marration of Fruits, and the changes Tasts, by which its usually know must needs be the effect of the Vertable Soul of the Plant. For, after the Fruit is gathered, and so, by being no longer a part of the Tree dos.

does, according to the most common opinion, cease to be a part of the living Plant, as a Hand or a Foot cut off is no more reckoned among the Lims of the man it belonged to; yet 'tis very possible that some Fruits may receive maturation, after they have been severed from the Plants that bore them. For, not to mention, that Apples, gathered somewhat before the time, by lying in heaps, do usually obtain a mellowness, which feems to be a kind or degree of Maturation; or that Medlars, gathered whilst they are hard and harsh, do become afterwards in process of time soft and better tasted; in which state though some say they are rotten, yet others think that supposed rottenness is the proper Maturity of that kind of Fruit: Not to mention these, I say, or the like Instances, 'tis a famous Assertion of several Writers of the Indian affairs, that the Fruit they call Bananas is usually gathered green, and hung up in bunches or clusters in the house, where they ripen by degrees,

grees, and have an advantageon change made both of their color and of their tast. And this an a cient acquaintance of mine, a litera and observing person, of whom in quired about it, assured me, he h himself lately tried and found to true in America. And indeed I not, why a convenient degree warmth, whether external from Sun and Fire, or internal from for degree of fermentation or analy gous intestine Commotion, may m (whether the Fruit be united tot Plant or no) put the saporifick & puscles into motion, and make the by various and insensible transcul ons, rub against each other, and the by make the little bodies more la der or thin, and less rigid, or cum and harsh, than they were before and by various motions bring Fruit they compose to a state when in it is more foft in point of com Stence, and abound in Corpuscles harsh and more pliable, than the were before, and more congruod

to the pores of the organ of Tast: And, in a word, make such a change in the constitution of the Fruit, as men are wont to express by the name of Maturity. And that fuch Mechapical changes of Texture may much alter the Qualities, and among them the Tast of a Fruit, is obvious in bruised Cherries and Apples, which in the bruised parts soon come to look and tast otherwise than they did beand the second s fore. The possibility of this is also chvious by Wardens, when flowly roafted in embers with fo gentle a fire, as not to burn off the paper they are wont to be wrapt in, to be kept clean from the ashes. And I have sten, in the bordering Country betwist France and Savoy, a fort of Pears, (whose name I now remember not,) which being kept for some hours in a moderate heat, in a Vessel exactly closed, with embers and ashes above and beneath them, will be reduced to a juicy Substance of a lovely red colour, and very sweet and lubious to the tast. Many other sorts of 34

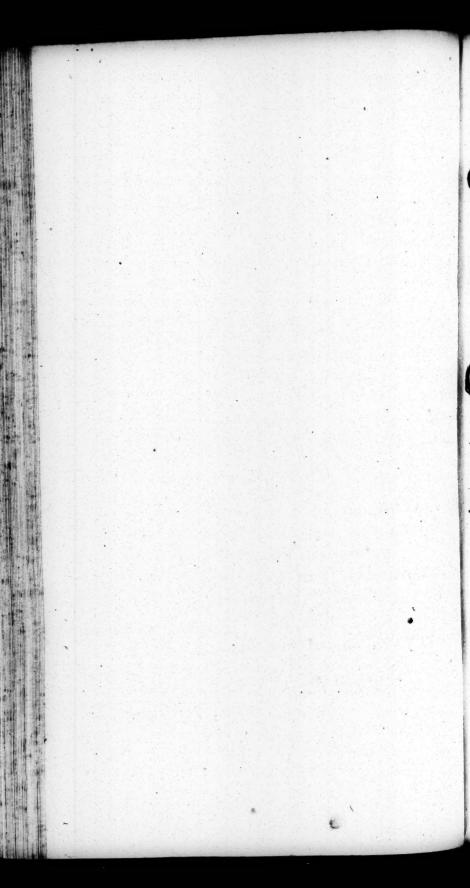
of Fruit in other Countries, if the were handled after the same way, otherwise skilfully wrought on by moderate heat, would admit as gree alterations in point of tast. Neith is that fort of Pear to be here on ted, which by meer Compression duly ordered, without external her will in a few minutes be brought exchange its former hardness and harfnness for so yielding a Conter ture and pleasant a tast, as I coul not but think very remarkable. A that even more folid and stubbe Salts than those of Vegetables, m have the sharpness and piercingness their tafts very much taken off the bare internal action of one pu upon the other, without the addition of any sweetning body, I have be induced to think by having found upon trial, that, by the help of it pid Water, we may, without any olence of Fire, reduce Sea-falt into Brine of so mild and peculiar (I h almost said) pleasant a tast, that of would scarce suspect what it had been

been, or believe that so great a change of a Mineral body could be effected by so slight an intestine Commotion as indeed produced it; especially, fince the alteration of tasts was not the most considerable that was

produced by this Operation.

As to Liquours that come from Vegetables, the emerging of new sapors upon the intestine Commotion of the saporifick parts, as Consequences of fuch Commotions, is more obvious than is commonly considered in the juice of Grapes, which, from a sweet and spiritles Liquour, do by that internal motion we call Fermentation, acquire that pleasing pungency and briskness of tast that belongs to Wine, and afterwards degenerates into that acid and cutting tast that is proper to Vinegar; and all this, by a change of Constitution made by the action of the parts themselves on one another, without the help of any external additament.

FINIS.



EXPERIMENTS,

AND

OBSERVATIONS,

About the

Mechanical Production

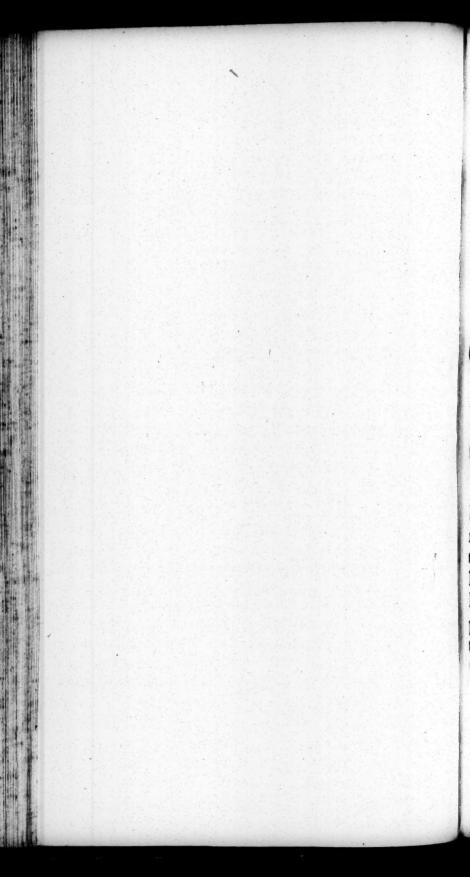
OF

ODOURS.

By the Honourable ROBERT BOYLE Esq; Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.



EXPERIMENTS,

AND

OBSERVATIONS,

About the

Mechanical Production

OF

ODOURS.

Since Tasts and Odours (perhaps by reason of the nearness of the Organs they affect) are wont, by Physical Writers, to be treated of next to one another, I also shall imitate them in handling those two Qualities, not onely for the intimated Reason, but because, what I have premised in general, and some other things that I have said already under the Title of Tasts, being applicable A 2

of the Bethanical to Odours also, 'twill not be necessary, and therefore 'twould be tedious to repeat them here.

EXPER. I.

With two Bodies, neither of them or rous, to produce immediately a street Urinous Smell.

Ake good Quick-lime and Armoniac, and rub or go them well together, and hold your Nose to the mixture, your be saluted with an Urinous sa produced by the particles of them latil Salt, untied by this operate which will also invade your Eyes, make them to water.

EXPER. II.

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By the bare addition of common Water, to produce immediately a very strong smell in a Body that had no such smell before.

"His is one of the Phænomena of an Experiment made with Camphire and Oil of Vitriol, which Ihave elsewhere mentioned to another purpose. For, if in that corrosive Menstruum you dissolve a good proportion, but not too much, of the strongly sented Gum, the odour of the Camphire will be quite concealed inthe mixture; but if you pour this mixture into a good quantity of fair Water, the dissolved Gum will immediately recover out of the Menfruum, and smell as strong as before, if not (by reason of the warmth produced in the Operation) strongly.

A 3 E X.

EXPER. III.

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Of producing some Odours, each of the quite differing from that of am the Ingredients.

Aving taken two ounces parts) of clear Oil of Turn tine, and mixt it with one ounce part) of Oil of Vitriol, (which be done by degrees, for other the Vessel will be endangered,) clear Liquour that came over, un the distillation of the mixture in Sand-furnace, in stead of the od of Turpentine, (for the Oil of Vital alone is wont to be inodorous,) [m] very strong of Sulphur; infomm that once, when I shewed this Em riment, approaching my Nose w boldly and hastily to the Received newly severed from the Retort, the Sulphureous stink proved so strong that it had almost (to speak with the vulgar) taken away my breath. An to illustrate yet farther the possible emer emergency of such odours upon the mixture of Ingredients, as neither of them was apart endowed with, we caused the substance that remained behind in the Retort (in the form of a thin extract) after one of the newly mentioned Distillations to be farther pressed by a stronger sire, which forced most of it over, partly in the some of a thick Oil, and partly in that of Butter; both which we keep together in the same Vial, because their odour is neither that of Oil of Turpentine, nor that of Brimstone, but they smell exceedingly like the distilled Oil of Bees-wax.

EXPER. IV.

About the production of some Odours by Local mention.

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I Shall not now examine, whether the Local motion of an external Agent may not, without materially concurring to the operation, pro-

duce, by agitating and shuffling the parts, odorous corpuscles: But the the celerity and other modification of the Local motion of the effluviat Bodies may not onely serve to dive fifie their odours, but so far produ them, as to make them perceptil by the fense, which otherwise woll. not be fo, may be gathered from for observations, which, being obvious are not so proper for this place Wherefore I shall rather take notice that I know feveral Bodies that it not onely inodorous when cold, by when confiderably hot, and are fixed l the fire, and yet, by having the parts put into a peculiar kind of a tation, will presently grow plain odorous. On this occasion is add, that, as there are some very had Woods, that acquire a strong full by the motion they may be exposed to in a Turner's Lath, ie RI haved ferved by trialls partwellarly made with the hard and ponderous Ligne Vita,) so some afford, whilst the op ration lasts, an unexpected odou And having inquired about this matter of two eminent Artists, (whom I often employ,) concerning the odour of Beech-wood whilst it is turning, they both agreed, that it would emit well-sented effluviums. And one of them affirmed to me farther, that, having bought a great block of that Wood, to make divers pieces of workmanship with it, when he came to turn it, there would issue out not onely a copious odour, but of such a peculiar fragrancy, that one that knew not whence it proceeded would have concluded he was smelling Roses.

EXPER. V.

By mixing a good proportion of a very frongly sented Body with an almost inodorous one, to deprive it speedily of all its smell.

Take Salt of Tartar, and drop upon it either Spirit of Nitre of Aqua fortis not too much dephlegmed,

phlegmed, till all the effervescence cease, and the Liquour will no longe work upon the Alkali. Thefe, by flow Evaporation of the superfluon moisture, may be made to shoot in Crystalls like those of Nitre, which after you have (if need be) by rul bing them with a dried cloath, free them from loofe adhering Com scles, will emulate Salt-peter, asi other Qualities, so in its not beime dorous; though, if you distill them, or burn them on kindled coals, their fumes will quickly make you for fible, that they abounded with the Stinking Spirits, that make Aqua forth so offensive to the smell.

EXPER. VI.

By putting a very strongly stinking Body to another of a not sweet smell, to produce a mixture of a pleasant and strongly Aromatick odour.

What is here proposed is performed at the same time that the Eleventh of the foregoing Experiments of Tasts is made. For the Liquour thereby produced, if it be well prepared, has not onely a spicy tast, but also a kind of Aromatick and pleasant smell; and I have some now by me, that, though kept not over-carefully, does, after some years, retain much of its former odour, though not so much as of its tast.

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EXPER. VII.

By digesting two Bodies, neither of them well sented, to produce Bodies of wery subtile and strongly fragram odour.

of Spanish Wine, and putto of Spanish Wine, and putto it some ounces of Oil of Vitriol; then, keeping them for a reasonable time in digestion, we obtained, as we expected, a mixture odoriferous enough. But this Triall you will find improved by that which insues.

EXPER. VIII.

By the bare addition of a Body almost inodorous, and not well sented, to give a pleasant and Aromatick smell to Spirit of Wine.

This we have several times done, by the ways elsewhere related for another scope, the summ of which, as far as it needs be mentioned in

this place, is this.

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We took good Oil of blew Vitriol (that was brought from Dantzick,) though the very common will serve well, and having put to it, by degrees, an equal weight of Spirit of Wine totally inflammable, we digested them together, for two, three, or four weeks, (sometimes much longer, and then with better success;) from which, when we came to distill the mixture, we had a very fragrant Spirit, which was sometimes so subtile, that, though distilled in a tall Glass with a gentle Heat, it would (in

(in spite of our care to secure closeness of the Vessels at the ju ctures) pierce through, and fill the Laboratory with a perfume, which though men could not guess whath dy afforded it, yet they could it but wonder at it. Whence we m learn, both how much those spiritus and inflammable particles, the Ch mists call the vegetable Sulphur Wine, may work on and ennoble mineral Sulphur; (for, that such as one there is in Oil of Vitriol, Ihm elsewhere proved by experience and how much the new Commission and Contextures made by digefting may alter the odours of Bodies, wh ther Vegetable or Mineral. also another Constitution of the land matter, without any manifest adding or receis of particles, may prom to exhibit a very differing smell, w appear by the following Triall.

EXPER. IX.

To make the forementioned fragrant Body, without addition or fire, degenerate into the rank smell of Garlick.

To make out this, I need onely relate, that I have more than once put the above mentioned fragrant Liquour in stopt Glasses, whereof the one, and not the other, stood in a warm place, till in process of time I found that odoriferous Liquour so to degenerate in point of sent, that one would have thought it to have been strongly infected with Garlick. And the like unpleasant smell I observed in a certain Oil made of Vegetable and Mineral Substances distilled together.

And on this occasion I will add, (though not as an Argument,) this Observation, which though I shall not undertake it will always succeed, I think may not impertinently be set

down

down in this place, partly becaused the likeness of the odour produced to that which was the effect of the last named Triall; and partly (orm ther chiefly) because it may shew that a Body, which it self is not one inodorous, but very fixt, may ye in some cases, have a great stroker the Phanomena of Odours; whether by being wrought on by, and form times mingled with, the parts of the odorous body, and thereby giving it a new modification, I shall not of now stay to enquire.

We took then good Salt of Tatte at and put to it several times its weighth of the expressed juice of Onions; th kept them in a light digestion of P day or two, and then unstopping the Vial, we found the former smell me the Onions quite degenerated in the rank smell of Garlick, as was judge the even when fresh juice of Garlick P procured to compare them. To the ry this Experiment, we made wind fixt Salts, and some other strong mi sented Juices, Trialls, whose even

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twould perhaps be tedious here to relate.

EXPER. X.

With an inodorous Body, and another not well-sented, to produce a muskie smell.

His we have sometimes done by casting into Spirit (not Oil) of Vitriol a large proportion of small Pearls unbroken. For the action of the acid Menstruum upon these being moderated, partly by the weakness of the Menstruum, and partly by the intireness of the Pearls, the dissolution would sometimes last many hours. Holding from time to time my nose to the open orifice of the Glass, 'twas easie to perceive a pleasant muskie smell, which also others, to whom I mentioned it, took notice of as well as I. And, if I misremember not, I took notice of the like smell, upon Pearls not onely diffol-B

dissolved in Spirit of Vinegar, buti another Liquour that had but a by fent of its own. The foregoing E periment calls to my mind that whit follows.

EXPER. XI.

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With fixt Metals, and Bodies either odorous or flinking, to produ strong and pleasant Smells, likely of some Vegetables and Mineral

Hat Gold is too fixt a body emit any odour, and that qua Regis has an odour that is m strong and offensive, I think will eafily granted. But yet Anrunt minans being made (as 'tis know by precipitating with the inodu Oil of Tartar the Solution made the former in the latter, and Precipitate being to be farther m 1 ceeded with in order to another li periment; we fulminated it pr in a Silver Vessel like that, but be

ter contrived, that is (if I misremember not) somewhere described by And among other Pha-Glauberus. nomena of this operation, that belong not to this place, we observed with pleasure, that, when the fulmination was recently made, the steams, which were afforded by the metal that had been fired, were endowed with a delightful smell, not unlike that of musk. From which Experiment and the foregoing we may learn, that Art, by lucky Contextures, may imitate the odours that are prefumed to be natural and specifick; and that Mineral and Vegetable Substances may compound a smell that is thought to be peculiar to Animals.

And as Art sometimes imitates Nature in the production of Odours, as may be confirmed by what is above related concerning counterfeit Ras-

berry-Wine, wherein those that drank it believed they did not onely tast, but smell the Ras-

See in the Paper of Tasts, Exper. XII.

berry; so sometimes Nature seems

to imitate her self, in giving like o dours to bodies extreamly differing For, not yet to dismiss the smell of Musk, there is a certain Seed, which for the affinity of its odour to the perfume, they call the Musk-feed; and indeed, having some of it present me by a Gentleman, that had new brought it from the West-Indies, found it, whilft 'twas fresh, to han a fragrancy suitable to the nametha was given it. There is also a lond Rats in Muscovy, whose skins for whereof I have seen several, have is fmell that has procured them thenan of Musk-Rats. To which I know not, whether we may not add mention of a certain fort of Duck which some call Musk-Ducks, beant at a certain season of the year, if be chaf'd by violent motion, by will under the wing emit a mul in stead of a sweaty lent; whichup trial I perceived to be true. Ont other fice, I have known a certi Wood growing in the Indies, while especially when the sent is excited

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subbing, stinks so rankly and so like Paracelsus's Zibetum Occidentale, (stercus Humanum,) that one would swear it were held under his Nose. And fince I have been speaking of good fents produced by unlikely means, I shall not pretermit this Obfervation, that, though generally the fireimpresses a strong offensive smell, which Chymists therefore call Empreumatical, upon the odorous bodies that it works strongly on; yet the constitution of a body may be fuch, that the new Contexture that is made of its parts, even by the violence of the fire, shall be fit to afford Effluviums rather agreeable to the organs of imelling, than any way offensive. For I remember, that, having for a certain purpose distilled Sucharum Saturni in a Retort with a frong fire, I then obtained, (for I dare not undertake for the like fuccesto every Experimenter,) besides a piercing and Empyreumatical Liquour that was driven over into the Receiver, a good Lump of a Caput B 2 MorMortuum of a grayish colour, which the notwithstanding the strong impress d on it had received from the fire, w fo far from having any Empyreum fe tical fent, that it had a pleasing on I and when 'twas broken, smelt alme a like a fine Cake new baked, and bin n ken whilst yet warm. And as the fire, notwithstanding the Empyreum it is wont to give to almost all the bodies it burns, may yet be reduced of to confer a good smell on some of them, if they be fitted upon lun r contexture of their parts to en t steams of such a nature, (whatever were the efficient cause of such acon t texture;) so we observe in the la i animal, that Nature in that Cat, I rather Deer, (though it properly) long to neither kind,) produces May by fuch a change, as is wont in the Animals to produce a putrefating think. So that, provided a due constitution of parts be introduced in a portion of matter, it may onthe account be endowed with noble as desirable Sents, or other Qualities thoug

though that Constitution were introduced by such unlikely means, as Combustion and Putrefaction themselves. In Confirmation of which, I shall subjoyn in the insuing account a notable, though casual, Phænomenon, that occurred to a couple of

virtuos of my Acquaintance.

An eminent Professor of Mathematicks affirmed to me, that, chancing one day in the heat of Summer with another Mathematician (who I remember was present when this was told) to pass by a large Dunghil that was then in Lincolns-Inn-fields, when they came to a certain distance from it, they were both of them surprized to meet with a very strong smell of Musk, (occasioned, probably, by a certain degree or a peculiar kind of Putrefaction,) which each was for a while shy of taking notice of, for fear his Companion should have laughed at him for it; but, when they came much nearer the Dunghill, that pleasing smell was succeeded by altink proper to such a heap of Ex-B 4 crements.

crements. This puts me in mindia adding, that, though the excrement of Animals, and particularly the fweat, are usually foetid; yet, the 'tis not the nature of an excrement but the constitutions, that usual C belong to them, make them fo, he the feemed probable to me upon for (Observations. For, not to mentia g what is related of Alexander it of Great, I knew a Gentleman of r very happy Temperature of buy, F whose sweat, upon a critical exmi nation, wherein I made use allow g surprize, I found to be fragran C which was confirmed also by for p Learned men of my acquaintant m and particularly a Physician that I with him.

Though Civet usually passes for a Persume, and as such is wont who had bought at a great rate; yet it seems to be but a clammy excrement of the training that affords it, which is secret into Bags provided by Natures for receive it. And I the rather me tion Civet, because it usually affor a Ph

Phanomenon that agrees very well with the Mechanical Doctrine concerning Odours, though it do not demonstrate it. For, when I have had the curiofity to visit divers of those Civet-Cats, (as they call them) though they have heads liker Foxes than Cats; I observed, that a certain degree of Laxity (if I may fo style it) of the odorous Atmosphere was requifite to make the smell fragrant. For, when I was near the Cages, where many of them were kept to gether, or any great Vessel full of Civet, the smell (probably by the plenty, and perhaps the over-brisk motion of the effluvia,) was rather rank and offensive than agreeable; whereas, when I removed into the next room, or to some other convenient distance, the steams (being less crowded, and farther from their fountain,) presented themselves to my. Noltrills under the notion of a Perfume.

And, not to dismiss this our Eleventh Experiment without touching once more

more upon Musk, I shall add, that Ingenious Lady, to whom I am near h ly related, hewed me an odd Monky that had been presented her as an rity by the then Admiral of England and told me, among other things, the had observed in it, that, being in he would feek for Spiders as his po per remedies, for some of which then seemed to be looking, at 1 thereby gave her occasion to tella this; which when he had eaten, the alteration it made in him would a fometimes fill the room with a mush i fent : But he had not the good lo to light on any whilst my visit laste b

EXPER. XII.

To heighten good smells by Comption.

and is easie to be observed that Amber-greece alone, thought steemed the best and richest persum

that is yet known in the world, has but avery faint and scarce a pleasant fent. And I remember, that I have seen some hundreds of ounces together newly brought from the East-Indies; but if I had not been before acquainted with the smell of Ambergreece alone, and had had onely the vulgar conceit of it, that 'tis the best and strongest of perfumes, my Nostrills would scarce have made me suspect those lumps to have been any thing a-kin to Amber-greece. But if a due proportion of Musk, or even Civet, be dexteroully mixt with Am ber, the latent fragrancy, though it be thereby somewhat compounded, will quickly be called forth, and exceedingly heightned. And indeed tis not, as 'tis commonly prefumed, the plenty of the richest Ingredients, as Amber-greece and Musk, but the just proportion and skilful mixture of them, that makes the noblest and most lasting perfume; of which I have had sufficient experience; so that with a far less quantity of Musk and

and Amber, than not onely ordinar persons, but Persumers themselve are wont to imploy, we have hadfe veral Perfumes, that for fragrand were much preferred to those when Musk and Amber-greece are so ples tifully imployed. The proportion and ways of mixture we best appro ved of, would be too long, and at not necessary, to be here set down but you will not much erre in making use of such a proportion as this, viz. eight parts of Amber-greece, twoof Musk, and one of Civet: which quantities of Ingredients if they h skilfully and exactly mingled, yo will not miss of a good Composition with which you may innoble other materials, as Benzoin, Storax, Swett Flowers, &c. fit to make Palilly Ointments for Leather, Pom And we may here ad, that, upon the score of the new Ter ture acquired by Composition, for things, that are not fragrant then selves, may yet much heighten th fragrancy of Odoriferous bodies

And of liquid perfumes I remember, 'twas the secret of some Court-Ladies, noted for Curiofity about perfumes, to mingle always a due proportion of Wine-vinegar with the odoriferous Ingredients. this occasion, to shew the power of mixtures in improving Odours, I shall add something about a Liquour of mine, that has had the good fortune to be very favourably spoken of by persons of Quality accustomed to choice Perfumes. This Liquour; though thought an elaborate preparation, as well for another reason, as to recommend it to some, whose Critical palates can tast the very titles of things, I called it Essence of Musk, is indeed a very plain simple preparation, which I thus make.

I take an arbitrary Quantity of choice Musk without finely powdering it, and pour upon it about a finger's breadth of pure Spirit of Wine; these in a Glass closely stopt let in a quiet place to digest, without the help of any Furnace, and

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after some days, or a few weeks, at cording as Circumstances detemp ned,) the Spirit, which is for s what odd, will in the cold have me a solution of the finest parts of Musk, and will be thereby mu t tinged, but not of a red color d This Liquour being decanted keep by it felf as the richeft of and pour a like quantity of Spir on the remaining Musk, which w fually will in the cold, though more flowly, draw a tincture, but faint than the former, which being por red off, the remaining Musk may imployed for inferiour uses. No that which made me mention this Pr paration as pertinent to our prefe Subject, is this Phænomenon of that the first essence, or rather Eture, being smelt to by it self, but a faint, and not very pleafing, dour of Musk, so that every bot would not discover that there Musk in it; but if a fingle drop, two drops at most, were mixt with pint, or perhaps a quart, of good Sad

the whole body of the Wine would presently acquire a considerably musky sent, and be so richly persumed both as to tast and smell, as seemed strange enough to those that knew the vast disproportion of the Ingredients.

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OF THE

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OF THE

Chymist's

DOCTRINE

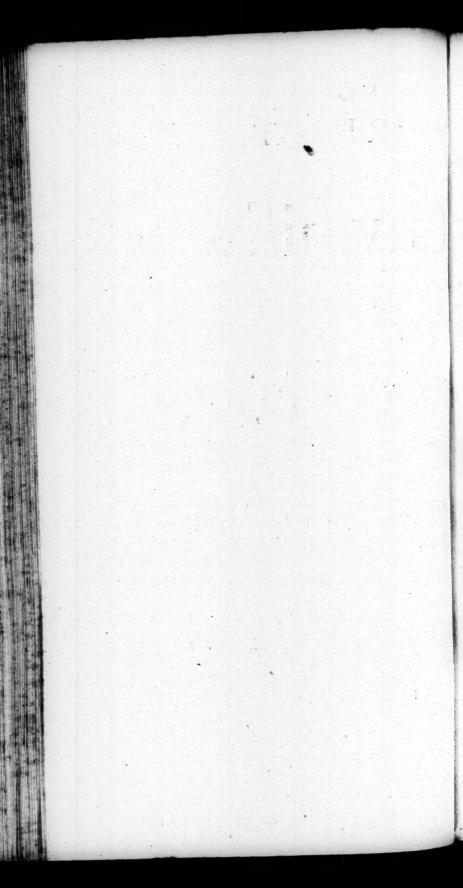
OF

QUALITIES.

By the Honourable ROBERT BOYLE Esq; Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.



OF THE

IMPERFCTION

OF

The Chymist's Doctrine

OF

QUALITIES.

CHAP. I.

Since a great part of those Learned Men, especially Physicians, who have discerned the defects of the vulgar Philosophy, but are not yet come to understand and relish the Corpuscularian, have slid into the Doctrine of the Chymists; and since the Spagyrists are wont to pretend to make out all the Qualities of bodies from the Predominancy of some one of their three Hypostatical.

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4 Impersention of the Chymiss Principles, I suppose it may both keep my opinion from appearing too presumptuous, and (which is far more considerable) may make way for the fairer Reception of the Mechanical Hypothesis about Qualities, if there intimate (though but briefly and in general) some of those defects, the I have observed in Chymists Explications of Qualities.

And I might begin with taking no. tice of the Obscurity of those Pinciples, which is no small desed in Notions whose proper office it should be to conduce to the illustration of others. For, how can that facilitate the understanding of an obscur Quality of Phanomenon which in felf scarcely intelligible, or at les needs almost as much explanations the thing 'tis designed & pretended to explicate? Now a man need m be very conversant in the writing of Chymists to observe, in how Laxe Indefinite, and almost Arbitrary See fes they employ the Terms of 8th Sulptur and Mercury; of which could

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could never find that they were agreed upon any certain Definitions e. or setled Notions; not onely differing Authors, but not unfrequently one and the same, and perhaps in the fame Brook, employing them in very differing senses. But I will not give the Chymists any rise to pretend, that the chief fault that I find with their Hypothesis is but verbal; though that it felf may not a little blemish any Hypothesis, one of the first of whose Requisites ought to be Clearness; and therefore I shall now advance and take notice of defects that are manifestly of another kind.

Andfirst the Doctrine that all their Theory is grounded on, feems to me Inevident and undemonstrated, not to fay precarious. It is somewhat strange to me, that neither the Spagyrists themselves, nor yet their Adversaries, should have taken notice, that Chymists have rather supposed than evinced, that the Analysis of bodies by fire, or even that at least some Analysis is the onely instrument of in-

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vestigating what Ingredients mixt be dies are made up of, since in diven cases That may be discovered by Composition as well as by Resolution; as it may appear, that Vitriol consists of metalline parts (whether Martial, or Venereal, or both) associated by Coagulation with acid one one may, I say, discover this as we by making true Vitriol with Spin (improperly called Oil) of Sulphur, or that of Salt, as by distilling or he solving Vitriol by the fire.

But I will not here enlarge on the subject, nor yet will I trouble you with what I have largely discounsed the sceptical Chymist, to call in question the grounds on which Chymist affert, that all mixt bodies are compounded of salt, sulphur, and the cury. For it may suffice me now tell you, that, whatsoever they may be able to obtain from other bodies it does not appear by Experience which is the grand, if not the ones, Argument they rely on, that all min bodies that have Qualities, consisted their

their tria prima, fince they have not been able, that we know, truly, and without new Compositions, to refolve into those three, either Gold, or silver, or Crystal, or Venetian Talck, or some other bodies, that I elsewhere name; & yet these bodies are endowed with divers Qualities, as the two former with Fusibleness and Malleability, and all of them with Weight and Fixity; fo that in these and the like bodies, whence Chymists have not made it yet appear, that their Salt, Sulphur and Mercury, can be truly and adequately separated, 'twill scarce be other than precarious, to derive the malleableness, colour, and other Qualities of such bodies from those Principles.

Under this Head I confider also, that a great part of the Chymical Doctrine of Qualities is bottom'd on, or supposes, besides their newly questioned Analysis by fire, some other things, which, as far as I know, have not yet been well proved, and I que-

stion whether they ever will be.

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8 Imperfection of the Chymilis

One of their main Suppositions is that this or that Quality must have its πρώπν δεκθικόν, as Sennertus, the Learnedst Champion of this opinion calls it, or some particular materia Principle, to the participation which, as of the primary native and genuine subject, all other bodies mu owe it: But upon this point having purposely discoursed elsewhere. shall now onely observe, that, note mention Local motion and Figure, I think 'twill be hard to shew, what is the Tento Sentino of Gravity, Volt tility, Heat, Sonorousnels, Transp. rency and Opacity, which are Qu lities to be indifferently met within bodies whether fimple or mixt.

And whereas the Spagyrists at wont to argue, that, because this a that Quality is not to be derived truly from this or that particular Principle as Salt, for instance, and Mercury therefore it must needs be derivable from the third, as Sulphur. This way of arguing involves a farther Supposition than that newly examined.

For it implies, that every Quality in a compounded body must arise from some one of the tria prima, whereas experience assures us, that bodies may, by Composition, obtain Qualities, that were not to be found in any of the separate Ingredients. As we fee in painting, that though blew and yellow be neither of them green, yet their mixture will be so. And though no fingle Sound will make an octave or diapason; yet two sounds, whose proportion is double, will have an eighth. And Tinn and Copper melted and mingled together in a due proportion, will make a bell-metal far more sonorous than either of them was before. 'Tis obvious enough for Chymists themselves to observe, that, though Lead be an infipid body, and Spirit of Vinegar a very sharp one, yet Saccharum Saturni, that is compounded out of these two, has a sweetness that makes it not ill deserve its name.

But this ill-grounded Supposition of the Chymists, is extended farther

10 Imperfection of the Chymitis in an usual Topic of theirs, according to which they conclude, That I know not how many Qualities, as well m nifest as occult, must be explicant by their tria prima, because they a not explicable by the four element of the Peripateticks. To make which argumentation valid, it must be po ved, (which I fear it will never be that there are no other wayes, h which those Qualities may be expli cated, but by a determinate number of Material Principles, whetherfour or three: Besides that, till they have shewn that such Qualities may bein telligibly explicated by their Pin ciples, the objection will lye as from for the Aristotelians against them, for them against the Aristotelians.

CHAP. IL.

Dext I consider, that there are divers Qualities even in min bodies, wherein it does not appear that the use of the Chymical Doding

is Necessary. As, for instance, when pure Gold is by Heat onely brought to fusion, and consequently to the state of fluidity, and upon the remisfion of that heat, grows a folid and confistent body again, what addition or expulsion or change of any of the tria prima does appear to be the cause of this change of confistence? Which is easie to be accounted for according to the Mechanical way, by the vehement agitation that the fire makes of the minute parts of the Gold to bring it to fusion; and the cohesion of those parts, by vertue of their gravity and fitness to adhere to one another, when that agitation ceases. When Venice Glass is meerly by being beaten to pouder deprived of its Transparency and turned into a body opacous and white, what need or use of the tria prima have we in the explication of this Phænomenon? Or of that other which occurs, when by barely melting down this white and opacous body it is deprived of its opacity and colour, and becomes diaphadiaphanous? And of this fort of hy frances you will meet with diversit the following Notes about particular Qualities; for which reason I had forbear the mention of them her mention of the me

CHAP. III.

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Observe too, that the Spagyric th Doctrine of Qualities is Insuffic the ent and too narrow to reach to all he the Phænomena or even to all the lin notable ones, that ought to her h plicable by them. And this Infuffed ar ency I find to be two-fold; for, if the there are divers Qualities, of which of Chymists will not so much as attement to give us explications, and of other ways. particular Qualities the explication, fic fuch as they are that they given to are often very deficient and unlaw by factory; and do not sometime ab much as take notice of divers con tai derable Phænomena that belong find the Qualities whereof they preise Hy to give an account; of which yo are

will meet with divers Instances in the insuing Notes. And therefore I shall onely, (to declare my meaning the better,) invite you to observe with me, that though Gold be the body they affect to be most conversant with; yet it will be very hard to shew. how the specific weight of Gold can be deduced from any or all of the three Principles, fince Mercury it felf, that is of bodies, known to us, the heaviest next to Gold, is so much lighter than Gold, that, whereas I have usually found Mercury to be to an equal weight of water, somewhat, though little, less than fourteen to one, I find pure Gold to be about nineteen times as heavy as so much water. Which will make it very difficult, not to say impossible for them to explain, how Gold should barely by participating of Mercury, which is a body much lighter than it felf, obtain that great specific gravity we find it to have; for the two other Hypostatical Principles, we know, are far lighter than Mercury. And I think

14 Imperfection of the Chymitis think it would much puzzle the Ch mists, to give us any examples of compounded body, that is specific ly heavier than the heaviest of Ingredients that it is made up of. A this is the first kind of Insufficience was taking notice of in the Chymic Doctrine of Qualities.

The other is, That there are fer ral bodies which the most Learne among themselves confess not to con fift of their tria prima, and yet win dowed with Qualities, which code quently are not in those subjects t be explicated by the tria prima which are granted not to be found in the Thus elementary Water, though new so pure, (as distilled Rain-water, has fluidity and coldness and humid ty and transparency and volatily without having any of the tria print And the purest Earth, as Ashes can fully freed from the fixt falt, has go vity and confiftence and dryness colour and fixity, without own them either to Salt, Sulphur, or Me cury; not to mention, that thereat

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Celestial bodies which do not appear, nor are wont to be pretended, to consist of the tria prima, that yet are indowed with Qualities. As the sun has Light, and as many Philosophers think, Heat, and Colour; and the Moon has a determinate confistence and figuration, (as appears by her mountains) and Astronomers observe, that the higher Planets and even the Fixt stars appear to be differingly coloured. But I shall not multiply Instances of this kind, because what I have said, may not onely serve for my present purpose, but bring a great Confirmation to what llately faid, when I noted, that the Chymical Principles were in many cases not necessary to explicate Qualities: For fince in Earth, Water, &c. such districted Qualities, as gravity, fixtness, colour, transparency and fluidity, must be acknowledged not to be derived from the tria prima; 'tis plain, that portions of matter may be endowed with fuch Qualities by other causes and agents than Salt, Sulphur

16 Imperfection of the Chymilly Sulphur and Mercury. And the why should we deny, that also compounded bodies those Quality may be (sometimes at least) prote ced by the same or the like Cause As we see, that the reduction of diaphanous Solid to pouder, prod ces whiteness, whether the commonution happens to Rock-crystal to Venice glass, or to Ice: The first of which is acknowledged to be natural and perfectly mixt body; the second a factitious and not only mixt but decompounded body; and the last, for ought appears, and s mentary body, or at most very sign of ly and impersectly mixt. And so to mingling Air in small portions with for diaphanous Liquor, as we down we beat such a Liquor into foatly whiteness is produced, as well in present which is acknowledged to speak a simple body, as in white Windowhich is reckoned among persent the mixt bodies.

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CHAP. IV.

T Further observe, that the Chymists Explications do not reach deep and far enough. For first, most of them are not sufficiently distinct and full, so as to come home to the particular Phanomena, nor often times fo much as to all the grand ones, that belong to the History of the Quali-ties they pretend to explicate. You will readily believe, that a Chymist will not eafily make out by his Salt, Sulphur, and Mercury, why a Loadstone capp'd with steel may be made to take up a great deal more Iron, fometimes more than eight or tendimes as much, than if it be immediatly applied to the iron; or why, if one end of the Magnetic Needle is dispord to be attracted by the Norththe other Pole of the Load-stone, will not attract it but drive it away: or, why a bar or rod of iron, being heated red-hot and cooled perpendi-B cularly,

18 Impersection of the Chymik: cularly, will with its lower end din away the flower de Luce, or the North-end of a Marriners Need which the upper end of the same or rod will not repell but draw to In short, of above threescore Pa perties or notable Phænomen Magnetic Bodies, that some Win P have reckon'd up, I do not rement that any three have been by Chymi fo much as attempted to be folved u their three Principles. And evening those Qualities, in whose explicating ons these Principles may moreph p bably than elsewhere pretend to he a place, the Spagyrifts accounts wont to fall fo short of being diffi and particular enough, that they to leave divers confiderable Pha mena untouch'd, and do but 15 di lamely or flightly explicate them lin obvious or familiar. And I have good an opinion of divers of the w bracers of the Spagyrical Theon th Qualities (among whom I have de with very Learned and worthy the that I think that if a Quality be we

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pos'd to them, they were at the same time presented with a good Catalogue of the Phænomena, that they may take, in the History of it, as it were with one view, they would plainly perceive that there are more particulars to be accounted for, than at first they were aware of ; and divers of them fuch, as may quite difcourage confidering men from taking upon them to explain them all by the Tria prima, and oblige them to have recourse to more Catholic and comprehensive Principles. I know not, whether I may not add on this occasion, that, methinks, a Chymist, who by the help of his Tria Prima, takes upon him to interpret that Book of Nature of which the Qualities of bodies make a great part, acts at but a little better rate than her that feeing a great book written in a Cypher, whereof he were acquainted but with three Letters. should undertake to decypher the whole piece. For though 'tis like, he would in many words find one of the Letters of his fhort

20 Imperfection of the Chymic; short key, and in divers words to of them, and perhaps in some three; yet, besides that in most the words wherein the known L ter or Letters may be met with, the may be so blended with other known Letters as to keep him for decyphering a good part of thosey ry words, 'tis more than probable that a great part of the book would confift of words wherein none of h three Letters were to be found

CHAP. V.

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ND this is the first account, which I observe that the Ch al mical Theory of Qualities does of reach far enough: But there is a w ther branch of its deficiency. even, when the explications feen go come home to the Phænomena, to de are not primary, and, if I may the speak, Fontal enough. Tomaken of

appear, I shall at present imploy but these two Considerations. The first is, that those substances themselves, that Chymists call their Principles, are each of them indowed with feveral Qualities. Thus salt is a confistent, not a fluid, body; it has its weight, 'tis dissoluble in water, is either diaphanous or opacous, fixt or volatile, sapid or insipid; (I speak thus disjunctively, because Chymists are not all agreed about these things; and it concerns not my Argument, which of the disputable Qualities be resolved upon.) And sulphur, according to them, is a body fulible, inflammable, &c. and according to Experience, is consistent, heavy, &c. So that 'tis by the help of more primary and general Principles, that we must explicate some of those Qualities, which being found in bodies, suppo-sed to be perfectly similar or homogeneous, cannot be pretended to be derived in one of them from the other. And to fay, that 'tis the nature of a Principle to have this or that Quality, B 3

22 Imperfection of the Chymilly Quality, as, for instance, of Sulphu to be fusible, and therefore we a not to exact a Reason why it is to though I could say much by ways answer, I shall now only observe, this Argument is grounded but up a supposition, and will be of no for if from the primary affections of dies one may deduce any good l chanical Explication of Fusibility the general, without necessarily in poling fuch a Primigeneal Sulphur as the Chymists fancy, or deriving it from thence in other bodies. An indeed, fince not only Salt-peter, & falt, Vitriol and Allum, but Salta Tartar, and the Volatile Salt of Uni are all of them fulible; I do not will fee, how Chymists can derive the h fibleness even of Salts obtained their own analysis (such as Salta Tartar and of Urine) from the pu ticipation of the Sulphureous Ingred ent; especially since, if such an ! tempt should be made, it wouldow throw the Hypothesis of three Simple bodies, whereof they will have

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mixt ones to be compounded; and still twould remain to be explicated, upon what account the Principle, that is said to endow the other with such a Quality, comes to be endowed therewith it self. For tis plain, that a mass of Sulphur is not an Atomical or Adamantine body; but consists of a multitude of Corpuscles of determinate Figures, and connected after a determinate manner: so that it may be reasonably demanded, why such a Convention of particles, rather than many another that does not, constitutes a susible body.

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CHAP. VI.

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ND this leads me to a furth th Confideration, which makes ti look upon the Chymists explication cl as not deep and radical enough; for it is this, that, when they tell us, in fil instance, that the fusibleness of by dies proceeds from Sulphur, in al lo they fay true, they do but tell it what material Ingredient 'tis thathe d ing mingled with and dispers p through the other parts of a body si makes it apt to melt: But this doe of not intelligibly declare, what it is that makes a portion of matter b fible, and how the fulphureous light dient introduces that disposition in a the rest of the mass, wherewith it commixt or united. And yet its in t explications as these, that an inquisitive Naturalist chiefly looks after an which I therefore call Philosophica for And to shew, that there may be more to sontal explications, I shall out observe, that, not to wander from our present instance, Sulphur it self is fusible. And therefore, as I lately intimated, Fusibility, which is not the Quality of one Atome, or Par-ticle, but of an Aggregate of Particles, ought it self to be accounted for in that Principle, before the Fufibleness of all other bodies be derived from it. And 'twill in the following notes appear, that in Sulphur itself that Quality may be probably deduced from the convention of Corpuscles of determinate shapes and fizes, contexed or connected after a convenient manner. And if either nature, or art, or chance, should bringtogether particles endowed with the like Mechanical Affections, and associate them after the like manner. the resulting body would be fusible, though the component particles had never been parts of the Chymists primordial fulphur: And fuch particles so convening might perhaps have made Sulphur it felf, though before there had been no such body in the world.

26 Imperfection of the Chymilis And what I fay to the Chymists, that make the sulphuren Ingredient the cause of fusibility, easily, mutatis mutandis, be applie to their Hypothesis, that rather cribe that quality to the Mercurial the Saline Principle, and consequent ly cannot give a rational account the fulibility of Sulphur. Andther ! fore though I readily allow (as Ill have afterwards occasion to declar that Sulphur, or an other of them! prima, may be met with, and even a bound in several bodies endown with the quality that is attributed their participation of that Principle yet that this may be no certain fig. yet that this may be no certain in that the propos'd Quality must for from that Ingredient, you may per haps be affisted to discern by this lustration, That if Tin be duly min with Copper or Gold, or, as I have tried, with Silver or Iron, it will make them very brittle; and it is also Ingredient of divers other bodies the are likewise brittle, as blew, green, white, and otherwise colour'd, And which

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which are usually made of calcin'd Tin (which the Tradesmen call Puttu,) colliquated with the Ingredients of Crystal-glass and some small portion of Mineral pigment. But though in all the above-named brittle bodies, Tin be a considerable Ingredient; yet 'twere very unadvised to affirm, that Brittleness in general proceeds from For provided the folid parts of consistent bodies touch one another but according to small portions of their surfaces, and be not implicated by their contexture, the Metalline or other Composition may be brittle, though there be no Tin at all in it. And in effect, the materials of glass being brought to fusion will compose abrittle body, as well when there is no Puttee colliquated with them, as Calcin'd Lead by the when there is. action of the fire may be melted into a brittle mass, and even into transparent Glass, without the help of Tin or any other additament. And I need not add, that there are a multitude of other bodies, that cannot be pretended ed to owe their brittleness to any participation of Tin, of which they have no need, if the matter they consider wants not the requisite Mechanic Dispositions.

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And here I shall venture to add the way employed by the Chymil as well as the Peripateticks, of counting for things by the Ingred ents, whether Elements, Principles or other bodies, that they suppose them to confift of, will often frultate the Naturalists expectation of event which may frequently prove differ ing from what he promis'd himself,up on the Confideration of the Qualities of each Ingredient. For the enling Notes contain divers Instances wherein there emerges a new Quality differing from, or even contraryth any that is conspicuous in the Ingre dients; as two transparent bodie may make an opacous mixture, aye low body and a blew, one that is green, two malleable bodies, a britte one, two actually cold bodies, a hot

one, two fluid bodies, a confistent one, &c. And as this way of judging by material Principles hinders the foreknowledg of Events from being certain; fo it much more hinders the affignation of Causes from being satisfactory; so that perhaps some would not think it very rash to say, that those who judg of all mixt bodies as Apothecaries do of Medicines, barely by the Qualities and Proportions of the Ingredients (fuch as among the Ariflotelians are the four Elements, and among the Chymists the tria prima,) do, as if one should pretend to give an account of the Phanomena and operations of Clocks and Watches. and their Diversities by this, That some are made of brass wheels some of iron, some have plain ungilt wheels, others of wheels overlaid with Gold, some furnished with gutstrings, others with little chains, &c. and that therefore the Qualities and Predominancies of these metalls that make parts of the Watch, ought to have ascribed to them, what indeed flows

30 Impersection of the Chymiss flows from their Coordination at Contrivance.

CHAP. VII.

HE last defect I observe inte Chymical Doctrine of Qualties, is, that in many cases it agrees w well with the Phanomena of Natur. and that by one or both of these wis First, there are divers changes d Qualities, wherein one may wella pect, that a Chymical Principle should have a great stroak, and yet it do not at all appear to have fo. Helm considers, what great operations & vers of the Hermeticks ascribe this or that Hypostatical Principle and how many Qualities according to them must from it be derived, or scarce do other than expect, that great change as to those Qualite happening in a mixt body, shoulds least be accompany'd with some # table action of, or alteration in the Pin

Principle. And yet I have met with many instances, wherein Qualities are produced, or abolished, or very much altered, without any manifest introduction, expulsion, or considerable change of the Principle, whereon that Quality is said to depend, or perhaps of either of the two others: As when a piece of fine filver, that having been neald in the fire, and fuffer'd to cool leifurely, is very flexible, is made stiff and hard to bend, barely by a few stroaks of a hammer. And a string of a Lute acquires or loses a sympathy, as they call it, with another ftring of the same or another Instrument, barely by being either stretchedfo as to make an Unison with it, or screw'd up or let down beyond or beneath that degree of Tenfion.

To multiply instances of this kind would be to anticipate those, you will hereafter meet with in their due places. And therefore I shall pass on from the first sort of *Phanomena*, that savour not the Chymical Hypothesis about

about Qualities, to the other which confifts of those, wherein eitherthand does not happen which according their Hypothesis ought to happen, i the contrary happens to what accome ing to their Hypothesis may justlyh expected. Of this you will meet with o instances hereafter; I shall now tro ble you but with one, the betters in declare my meaning. 'Tis not us in known to those Chymists, that work A much in Silver and in Copper, that w the former will endure Ignition and q become red-hot in the fire, beforer in will be brought to fusion; and the the latter is yet far more difficult to be in melted down than the other; yet for you separately dissolve those two ad metalls in Aqua fortis, and by evapo M ration reduce them to Crystalk, th these will be brought to fusion in its very little time, and with a very mo Ti derate Heat, without breaking the no glasses that contain them. If you bla ask a vulgar Chymist the cause of (w this facility of fusion, he will prob Sil bly tell you without scruple, that is bei from

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from the saline parts of the Aqua fortis, which, being imbodied in the metals and of a very fufible nature, impart that easiness of fusion to the metals they are mixt with. According to which plaufible explication one might well expect, that, if the faline Corpuscles were exquisitly mingled with Tin, they would make it far more fusible than of it self it is. And yet, as I have elsewhere noted, when I put Tin into a convenient quantity of Aqua fortis, the metal being corroded, subsided, as is usual, in the form of whites of eggs, which being well dried, the Tinn was so far from being grown more fulible by the addition of the saline particles of the Menstruum, that, whereas 'tis known that simple Tin will melt long before itcome to be red-hot, this prepar'd Tin would endure for a good while not only a thorow ignition, but the blast of a pair of double bellows, (which we usually imploy'd to melt Silver and Copper it self,) without being at all brought to fusion. And

34 Imperfection of the Chymitis as for those Spagyrists that admit. most of them are granted to do, the all kinds of metals may be turnedim Gold by a very small proportion what they call the Philosophe Elixir, one may I think shew the from their own concessions, that vers Qualities may be changed en in such constant bodies as Metal without the addition of any confide able proportion of the simple logn dients, to which they are wont bal cribe those Qualities; provided the Agent, (as an efficient rather thank material Cause,) be able to make great change in the Mechanical fections of the parts whereof metal it acts on is made up. Thus we suppose a pound of Silver, a pour of Lead, and a pound of Ironto transmuted into Gold, each by again of the powder of projection, tinging powder, as a material Can is inconsiderable, by reason of the smallness of its bulk, and as anesti ent cause it works differing and the contrary effects, according to the polition

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position, wherein it finds the metal to betransmuted, and the changes it produces in the constituent Texture of it. Thus it brings Quick-filver to be fixt, which it was not before, and deprives it of the Fluidity which it had before; it brings Silver to be indisfolvable in Aqua fortis, which readily dissolved it before, and dissoluble in Aqua Reth, which before would not touch it; and which is very considerable to our present purpose, whereas it makes fron much more fusible than Mars, it makes Lead much less fusible than whilest it retained its pristine form, fince Saturn melts ere it come to igntion, which Gold requires to bring it to fusion. But this is proposed only as an Argument ad hominem, till the Truth of the transmutation of metals into Gold, by way of projection, be sufficiently proved, and the circumstances and phænomena of it particularly declared.

hat some learned modern Chymists would be thought to explicate divers

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36 Imperfection of the Chymitis of the Changes that happen to Bodie in point of Odours, Colours, &c. h faying that in such alterations thes phur or other Hypostatical Princip is intraverted or extraverted, or,as thers speak, inverted. But I confe to me these seem to be rather a terms then real explications. omit divers of the Arguments me tioned in this present Treatise, the may be applied to this way of solving the Phænomena of Qualities, one may justly object, that the supposed in traversion or Intraversion of Sulph can by no means reach to give ans count of fo great a variety of Odou Colours, and other Qualities as m be found in the changed portion matter we are speaking of. A which is more, what they call by the and the like names, cannot be do without Local motion transposing particles of the matter, and com quently producing in it a change Texture, which is the very things would infer, and which being support fed, we may grant Sulphur to be dies

bodies, without allowing it to be always necessary to produce the alterations in them, since Corpuscles so condition'd and contex'd would perform such Effects, whether Sulphur, assuch, did, or did not, make up the

Subject matter of the Change.

And now I shall conclude, and partly recapitulate what has been delivered in this and the two foregoing Chapters, with this summary consideration, That the Chymist's Salt, Sulphur and Mercury themselves are not the first and most simple Principles of Bodies, but rather primary Concretions of Corpuscles or Particles more simple than they, as being endowed only with the first, or most radical (if I may so speak) and most Catholick Affections of simple Bodies, namely Bulk, Shape, and Motion, or Rest; by the different Conventions or Goalitions of which minutest portions of matter are made those differing Concretions that Chymists name Salt, Sulphur and C 3 MerMercury. And to this Doctrine is will be consonant, that several Estacts of this or that Spagyrical Principle need not be derived from Sala for instance, or Sulphur as such, his may be explained by the help of some of those Corpuscles that I have lated call'd more Simple and Radical; and such Explications being more simple and Mechanical, may be thought upon that score more fundamental and satisfactory.

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CHAP. VIII.

Know it may be objected in a vour of the Chymists, that as the Hypostatical Principles, Salt, Sulphu and Mercury, are but three, so the Corpuscularian Principles are but very few; and the chief of them Bulk, Size, and Motion, are but three neither; so that it appears not whether Chymical Principles should a most

more barren than the Mechanical. To which allegation I answer, that, befides that these last nam'd Principles are more numerous, as taking in the Posture, Order, and Scituation, the Rest, and, above all, the almost infinitely diversifiable Contextures of the small parts, and the thence refulting structures of particular bodies, and fabrick of the world: Besides this, I say, each of the three Mechanical Principles, specified in the objection, though but one in name, is equivalent to many in effect; as Figure, for instance, comprehends not only Triangles, Squares, Rhombusses, Rhomboids, Trapezions, and a multitude of Polygons, whether ordinate or irregular; but, besides Cubes, Prismes, Cones, Spheres, Cylinders, Pyramids, and other Solids of known Denominations, a scarce numerable multitude of hooked, branched, Eel-like, screw-like, and other irregular bodies; whereof though these, and some others, have distinct appellations, yet the greatest part

40 Imperfection of the Chymilis part are nameless; so that it need bis no wonder, that I should make the Mechanical Principles fo mud at more fertile, that is, applicable to the production and explication of a far greater number of Phanomena, ha the Chymical; which, whilest the to are considered but as similar body N that are Ingredients of mixt and cond pounded ones, are chiefly variable th but by the greater or leffer quantity that is employed by Nature or An o to make up the mixt body. And L Painters observe, that Black and h White, though mixt in differing Pro a portions, will still make but light f and darker grays. And if it be fail n that these Ingredients, by the Tature resulting from their mixture a may acquire Qualities that neither A them had before; I shall answer, that to alledge this, is in effect to confess that they must take in the Mechanica and Principles, (for to them belongs the Texture or Structure of bodies) 10 al la fift the Chymical ones. And on the occasion, to borrow an illustration from

from our unpublished Dialogue of the Requisites of a good Hypothesis, I shall add, that a Chymist that should pretend, that because his three Principles are as many as those of the Corpufcularians, they are as sufficient as these to give an account of the Book of Nature, methinks, I say, he would do like a man that should pretend, that with four and twenty words he would make up a language as well as others can with the four and twenty Letters of the Alphabet, because he had as many words already formed, as they had of bare Letters; not considering that instead of the small number of variations that can be made of his words by Prepositions and Terminations, the Letters of the Alphabet being variously combined, placed and reiterated, can be eafily made to compose not only his four and twenty words, with their variations, but as many others as a whole language contains.

42 Imperfection of the Chymite

CHAP. IX.

Otwithstanding all that I had been obliged to C. been obliged to fay to the Dith advantage of the Chymical Print tie ples, in reference to the Explicate w of Qualities, I would not be thought to grant, that the Peripatetick har of reason to triumphas if their fourth th ments afforded a better Theory of Pe Qualities. For, if I had, together wit be leisure enough to perform such do Task, any obligation to undertakei ca I presume, it would not be difficul of to shew, that the Aristotelian Doding lit about particular Qualities is liables Chymical, and to some others not considerable; and that, to derive all the Phanomena their Doctrine ought a fa folve from substantial Forms and no fro Qualities Elementary, is to impose a or us a Theory more barren and pre carious than that of the Spage rifts.

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That to derive the particular Qualities of bodies from those Substantial Forms, whence the Schools would have them to flow, is but an insufficient and unfit way of accounting for them, may appear by this, that substantial Forms themselves are things, whose existence many Learned Philosophers deny, whose Theory many of them think Incomprehensible, and the most Candid and Judicious of the Peripateticks themselves confess it to be very abstruse; so that from such doubtful and obscure Principles we can hardly expect clear Explications of the nature and Phenomena of Qualities; not to urge, that the Aristotelim Definitions, both of Qualities in general, and of divers of the more familiar Qualities in particular, as Heat, Cold, Moisture, Diaphaneity, &c. are far enough from being clear and well framed, as we elsewhere have occasion to thew.

Another thing, which makes the Scholastic Doctrine of Qualities unsatisfactory, is, that it seldom so much

44 Imperfection of the Chymili as attempts to teach the Mannerh the Qualities themselves and the Effects or Operations are produc Of this you may elsewhere find Instance given in the Quality the wont to be first in the list, viz that Heat, which though it may intelle bly and probably be explicated by Corpuscular Hypothesis, yet in Peripatetic account that is given of is both too questionable and tot perficial to give much Contento Rational Inquirer. And indeed win that a substantial Form (as that of Fire) acts by a Quality (call'd He whose Nature 'tis to produce such effect (as to foften Wax or hard Clay) feems to be no other infa stance, than to say, that it product fuch an effect by some powerit to produce it. But what that port is, and how it operates, is that, which though we most desire to know, are left to feek. But to profecutet ! Imperfections of the Peripatetick # S pothesis, were to intrench upon w ther discourse, where they arenote filly

fully laid open. And therefore I shall now but lightly glance upon a couple of imperfections, that more particularly relate to the Doctrine of

Qualities.

And first I do not think it a Convincing Argument that is wont to be imployed by the Aristotelians for their Elements, as well as by the Chmists for their Principles, that, because this or that Quality, which they ascribe to an Element or a Principle, is found in this or that body, which they call mixt, therefore it must owe that Quality to the participation of that Principle or Element. For the ame Texture of parts or other modification of matter may produce the like Quality in the more simple and the more compounded body, and they may both separately derive it from the same Cause, and not one from the Participation of the other. So Water and Earth and Metals and Stones, &c. are heavy upon the account of the common Cause of Gravity, and not because the rest partake

46 Imperfection of the Chymits of the Earth; as may appear in B mentary water, which is as fimble body as it, and yet is heavy: Son ter and oil, and exactly deflegm'ds rit of Wine, and Mercury, and Metals and Glass of Antimony, Minium or calcin'd Lead, whilefth three are in fusion are fluid, big made so by the variously determine motions of their minute parts and ther Causes of Fluidity, and not the participation of water, simula arid Calces of Lead and Antinon are not like to have retained inthe fire so volatile a liquor as water, a fince Fluidity is a Quality that Me cury enjoys in a more durable m ner than Water it self: Forthat m talline liquor, as also Spirit of Win well Rectified, will not be brought to freeze with the highest degree of Cold of our sharpest winters, thou a far less degree of Cold would mit water cease to be fluid and turn it in Ice.

To this I shall only add (in the cond place,) that 'tis not unplease

to fee, how arbitrarily the Peripateticks derive the Qualities of bodies from their four Elements, as if, to give an instance in the lately named Quality, Liquidity, you shew them exactly deflegmed Spirit of Wine, and ask them, whence it has its great Fluidness, they will tell you from water, which yet is far less fluid than it, and this spirit of wine it self is much less fothan the flame into which the spirit of wine is easily resoluble. But if you ask, whence it becomes totally inflammable, they must tell you, from the fire; and yet the whole body, at least as far as sense can discover, is fluid, and the whole body becomes flame, (and then is most fluid of all;) fothat fire and water as contrary as they make them, must both be by vast odds predominant in the same body. This spirit of wine also, being a liquor whose least parts that are senfibleare actually heavy, and compose a Liquor which is seven or eight hundred times as heavy as Air of the same bulk, which yet experience shews

48 Imperfection of the Chymir, shews not to be devoid of weight and must be supposed to abound with Earthy particles, and yet this spin p tuous liquor may in a trice become the supposed to Flame, which they would have to ke the lightest body in the world.

But, to enlarge on this subjet 28 would be to forget, that the delighth of this Tract engages me to deal no Po with the Peripatetic School, but the spaggrical. To which I shall there to fore return, and give you this at be vertisement about it, that what bo have hitherto objected is meant a po gainst the more common and receive mi ed Doctrine about the Material Prin ciples of bodies reputed mixt, as in bel wont by vulgar Chymists to be ap plied to the rendring an account of gal the Qualities of substances Corpo real; and therefore I pretend not that the past objections should con clude against other Chymical Theo ries than that which I was concern ed to question. And if adept Philip fophers, (supposing there be such)

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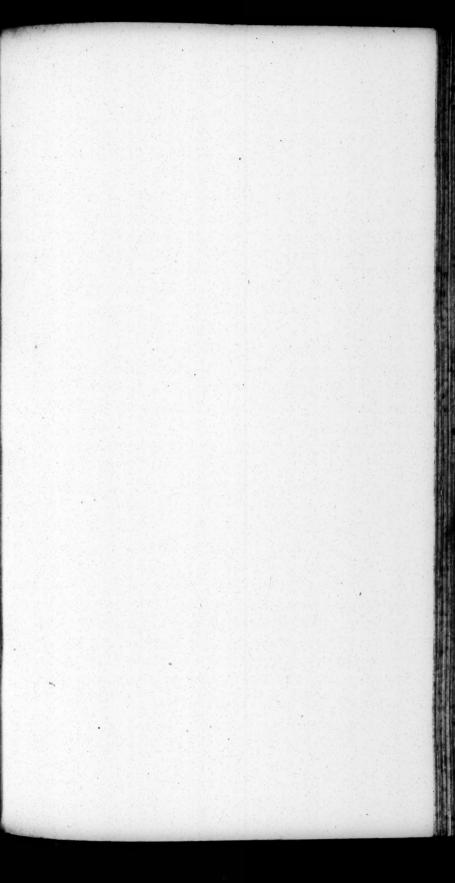
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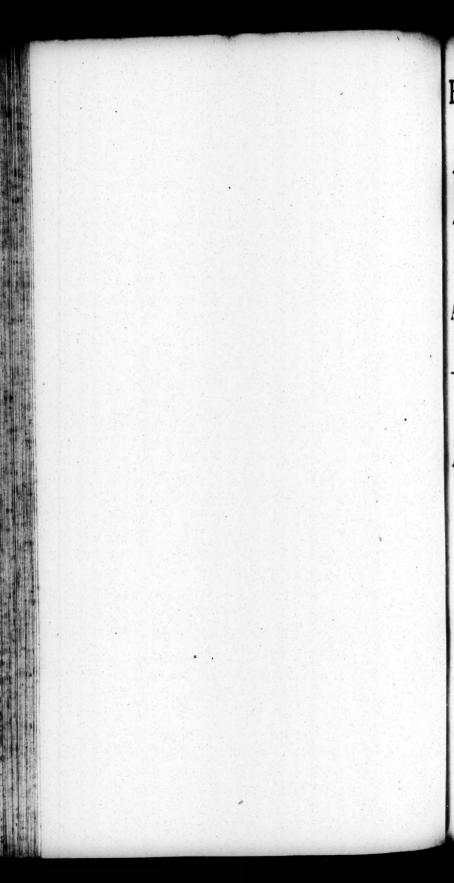
my other more than ordinarily Intelligent Spagyrists, shall propose any particular Hypotheses, differing from hose that I have questioned, as their Doctrine and Reasons are not yet known to me; so I pretend not that the past Arguments should conclude against them, and am willing to think, that Persons advantaged with such peculiar opportunities to dive into the Mysteries of Nature, will be able to give us, if they shall please, a far better account of the Qualities of bodies than what is wont to be proposed by the generality of Chymists.

Thus, dear Pyrophilus, I have laid before you some of the chief Imperfections I have observed in the vustigar Chymists Doctrine of Qualities, and consequently I have given you some of the chief Reasons that hinder me from acquiescing in it. And as my objections are not taken from the Scholastical subtleties nor the doubtful speculations of the Peripateticks or other Adversaries of the

Hermetick Philosophy, but from a nature of things and from Chymic experiments themselves; so I how if any of your Spagyrical friends has a minde to convince me, he will a tempt to doe it by the most proper way, which is, by actually giving clear and particular explications, least of the grand Phanomena of the lities; which, if he shall do, he will me very ready to acquiesce in a state that comes usher'd in, and endead to acceptable and useful a thing as Philosophical Theory of Qualities.

FINIS.





REFLECTIONS

UPON THE

Hypothesis

OF

ALCALI and ACIDUM.

By the Honourable ROBERT BOYLE Esq;

Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.

Hough the following Dicourse was at first write by way of Appendix to the Imtise of the Impersection of Chymical Doctrine of Qualities yet the bulk of it, swelling by yond what was foreseen, made seem expedient to publish it at Tract by it self.

REFLECTIONS

UPON THE

Hypothesis

OF

Alcali and Acidum.

CHAP. I.

Presume, it will not be difficult to discern, that much of what has been said about the Impersection of the vulgar Chymical Dodrine concerning Qualities, may with easie variations be applied to some other Hypotheses that are of kin to that Dodrine, and particularly to their A 2 Theory,

4 Reflections upon the Hypoth

Theory, that would derive both Qualities of Bodies and the rest of Phenomena of Nature from what call Acidum and Alcali. For the these two differences may be with in a great number and vain of bodies, and consequently Consideration of them may freque ly enough be of good use, (especia ly to Spagyrifts, and Physitians, who they are conversant about the sem dary and (if I may fo call them) (mical Causes and Operations of vers mixt bodies;) yet I confesso not acquiesce in this Hypothesis of A kali and Acidum, in the lating wherein I find it urged and applied the Admirers of it, as if it could usefully substituted in the place Matter and Motion.

The Hypothesis, being in a sorth ordinate to that of the tria prima, in ascribing to two contrary saline Prima, in ciples what vulgar Chymists do their salt, sulphur, and Mercury; and of the objections we have made gainst the vulgar Chymical Dodina

may;

may, as I lately intimated, be applied, by a little variation, to this, and therefore I shall need but to touch upon the main things that keep me from acquiescing in this Hypothesis.

CHAP. II.

ND first, it seems precarious to affirm, that in all bodies, or even inallthe sensible parts of mixts, Acid and Alcalizate paris are found; there not having been, that I know, any Experimental Induction made of particulars any thing near numerous enough to make out so great an affertion, and in divers bodies, wherein Experience is youch'd for the inexistence of these Principles, that Inexistence is indeed proved not by direct and clear experience, but upon a supposition, that such and such effects flow from the operations of the afsumed Principles.

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6 Reflections upon the Pypothefic

Some Spagyrifts, when they h Aqua fortis dissolve Filings of Con per, conclude from thence, that Acid spirits of the Menstruum meeti the metal with an Alcali upon while they work; which is but an unfa way of arguing, fince good Spirite Urin, which they take to be a volate Alcali, and which will make a gra Conflict with Aqua fortis, will, all have elsewhere noted dissolve film of Copper both readily, enougha more genuinly than the Acid liquoi wont to do. So when they fee the Magistery of Pearl or Coral, made by dropping oil of Tartar into solutions of those bodies made with spirit of Vinegar, they ascribe the Precipitation to the fixt Alcali ofth Tartar, that mortifies the Acidin of the spirit of Vinegar; whereasth Precipitation would no less insue, instead of Alcalizat oil of Tartar, w imploy that highly acid liquor which they call Oleum sulphuris per Cam panam.

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I think also it may be doubted, whether those, I reason with, are so certain as they suppose, that at least when they can manifestly discover an Acid, for instance, in a body, the operation of that body upon another, which they judge to abound with an alcali, must be the effect of a Conflid between those two jarring Principles, or, if I may so call them, Duellifts. For an Acid body may do many things, not fimply as an acid, but on the score of a Texture or modification, which endows it with other Qualities as well as Acidity, whose being affociated with those other Qualities in some cases may be but accidental to the effect to be produced; since by one or more of these other Qualities the body may act in cases, where Prejudice may make a Chymist consider Thus when nothing but Acidity. some Chymists see an acid Menstruum. as Aqua fortis, spirit of Salt, oil of Vitriol,&c. dissolve Iron, they presently ascribe the effect to an Acidity of the liquors, whereas well dephlegmed Uri-

8 Reflections upon the Pypothelis Urinous Spirits, which they hold have a great Antipathy to Acids, will as I have tried in some of them, real ly enough dissolve crude Iron eva in the Cold. And on the other fid Mercury will not work on the filing of Iron, though this be so open a men that even weak liquors will do and yet if one should urge, the Quickfilver readily disfolves Goldin Amalgamation, he may expect tob told, according to their Doctrine, the Mercury has in it an occult acid, by which it performs the folution whereas it feems much more probi ble, that Mercury has Corpufcles of fuch a shape and fize as fit them tois finuate themselves into the Commen furate Pores they meet with in Gold but make them unfit to enter readily the Pores of Iron, to which Nature has not made them congruous; ason the other fide the faline Corpufclesof Aqua fortis will easily find admission into the Pores of Iron, but not into those of Gold, to which they do not correspond as they do to the others

And when a knife, whose blade is touched with a Load-stone, cuts bread and takes up filings of Iron, it does neither of them upon the score of Alcali and Acidum, but the one upon the visible shape and the stiffness of the blade, and the other upon the latent Contrivance or change of Texture produced by the operation of the Load-stone in the particles that

compose the Steel.

This may perhaps be farther illustrated by adding, that when blew Vitriol, being beaten and finely fearced, makes a white pouder, that whiteness is a quality which the pouder has not as being of a Vitriolate Nature. For Rock-Crystal Venice-glass being finely beaten will have the same operation on the Eye, but it proceeds from the transparency of the body and the minuteness, multitude and confus'd scituation of the Corpuscles that make up the Pouder. And therefore, if other bodies be brought by Comminution into parts endow'd with fuch Mechanical affections, as we have name these aggregates will act upon the gans of Sight as whiteb odies.

CHAP. III.

ND this leads me to another Exception against the Hypnin Es of the Duellists, which is, that the Framers of it seem arbitrarily to have affigned Provinces or Offices to en of their two Principles, as the th mists do to each of their tria prin and the Peripateticks to each of the Four Elements. For tis not enough to Say, that an Acid, for instance, fuch, performs these things, and a Alkali so many others, that they vide the Operations and Phenomin of nature, or at least (as some, mon cautious, are content to fay) of min bodies between them; fince Affent ons of fuch great moment ought m to be advanc'd or received without sufficient Proof. And perhaps the very distribution of Salts into Acids and Alealies hath fomewhat of arbitrary in it, fince others may, without assuming much more, take the freedom to distribute them otherwise, there being not only feveral things wherein Acids and Alcalies agree, but also several things wherein Salts of the same denomination widely differ. As, for Instance, some Alkalies, according to those I reason with, are, like falt of Tartar, fixt, and will endure the violence of the fire; others, like falt of Urin or Harts-horn, are exceedingly fugitive, and will be driven up with a scarce sensible degree of Heat; some, as salt of Tartar, will precipitate the folution of Sublimate into an Orange-tawny; others, as spirit of Blood and Harts-horn, precipitate such a folution into a milky substance. Oil of Tartar will very flowly operate upon filings of Copper, which Spirit of Urin and Harts-horn will readily dissolve in the Fire.

12 Reflections upon the Pypothelic

And among Acids themselves the difference is no less if not much greater. Some of them will diffoli bodies that others will not, as Am fortis will dissolve Silver and Mercu ry, but leave Gold untouched; or Aqua Regis, though made without & Armoniac that diffolves Gold reading will dissolve Mercury but scurving and Silver not at all. And this ma happen, when the Men ftruum that wil not dissolve the body is reputed must stronger than that which does; dephlegm'd spirit of Vinegar wil dissolve Lead, reduc'd to minute patt in the cold; which is an effect the Chymists are not wont to expet from Spirit of Salt. Nay, whichis more, one Acid will precipitate what another has dissolved, and contrails as spirit of Salt will precipitate Silver out of spirit of Nitre. And I found oil of Vitriol to precipitate bodiesof divers kinds, Minerals and others, ou of some acid Menstruums, particularly spirit of Vinegar.

To this might be added the Properties, peculiar to some particular Acids, as that Spirit of Nitre or Aqua fortis will dissolve Camphire into an Oil, and coagulate common oil into a confistent and brittle substance like Tallow; and, though it will both corrode Silver, Copper, Lead, and Mercury, and keep them dissolved, it will quickly let fall almost the whole body of Tin, very foon after it has corroded as much as it can of it. all which, and some other like Instances, lam induc'd to question, whether the Acidum and Alkali, we are speaking of have the simplicity that Philolophy requires in Principles; and shall be kept from wondering, if others shall think it as free for them to constitute other Principles, as 'tis for the Learned men I reason with to pitch upon Acidum and Alkali.

And some perhaps will be bold to say, that, since the former of those Principles comprehend such a number of bodies, that are, many of them, very differing, and some of them directly

contrary

contrary in their operations, it seen a slight and not Philosophical a count of their Nature, to define a Acid by its Hostility to an Alcal which (they will say) is almost all one should define a Man by saying that he is an Animal that is at enum with the Serpent; or a Lyon, that is a fourfooted beast that slies from Crowing Cock.

CHAP. IV.

But although one of the chiefel Conditions that Philosopher may justly require in Principles, is that, being to explain other things they should be very clear themselves yet I do not much wonder, that the Definitions given us of Acidum and Alcali should be but unaccurate and superficial, fince I find not, that they have themselves any clear and determinate Notion or sure marks, where by to know them distinctly, without which

which Chymists will scarce be able to form clear and fetled Notions of them. For to infer, as is usual, that, because a body dissolves another, which is dissoluble by this or that known acid, the Solvent must also be acid; or to conclude, that, if a body precipitates a dissolved metal out of confessedly acid Menstruum, the Precipitant must be an Alcali, to argue thus, I fay, 'tis unsecure; fince, not to repeat what I said lately of Copper, I found, that filings of Spelter will be dissolved as well by some Alcalies, (as spirit of Sal Armoniac) as by Acids. And bodies may be precipitated out ofacid Menstruums, both by other Acids, and by liquors, where there appears not the least Alcalia As I have found, that a solution of Tinglass, made in Aqua fortis, would be precipitated both by Spirit of Salt and by common or rain water. And assor the other grand way that Chymilts employ, to distinguish Acids and Alcalies, namely by the Heat, Commotion, and bubbles that are excited, upon

16 Reflections upon the hypothe upon their being put together, the may be no such certain sign as the presume, they having indeed a depo dance upon particular Contexton and other Mechanical affections, to Chymists are not wont to take a notice of. For almost any thingth is fitted variously and vehemently agitate the minute parts of a bot, will produce Heat in it; and though water be neither an Acidm an Alcalizate liquor, yet it would quickly grow very hot, not on with the highly acid Oil of Vitro but (as I have more than once pur posely tried and found) with these ry Alcalizat Salt of Tartar. And to be noted, that neither in them nor the other of these Incalescent mixtures, there is produced any had visible or audible conflict, as, accord ing to the Doctrine of the Chymin I reason with one would expect, And as for the production of bubble, especially if accompanied with hissing noise, neither is that such a certain sign as Chymists imagine: for

the production of bubbles is not a necessary effect or concomitant of Heat excited by Conflicts, but depends very much upon the peculiar Disposition of Bodies put together to extricate, produce, or intercept particles of Air, (or Steams, for the time equivalent to them;) and therefore as Oil of Vitriol, mixt in a due proportion with fair water, may be brought to make the water too hot to be held in ones hand, without exciting bubbles; fol have found by trials purposely made, that Alcalizat Spirit of Urine drawn from some kinds of Quickline, being mixt with Oil of Vitriol moderately strong, would produce an intense Heat, whilest it produced either no manifest bubbles at all, or scarce any, though the Urinous Spint was strong, and in other Trials operated like an Alcali; and although also with Spirit of Urin, made per fe the common way, the oil of Vitriol will produce a great hiffing and a multitude of conspicuous bubbles.

18 Reflections upon the Pypothetic On the other fide I have sometime though not fo constantly, found, some Acid Spirits, especially that of Verdigrease made per Se, would, who poured upon Salt of Tartar, makes Conflict with it, and produce a con ous froth, though we observed it to to be accompanied with any manife And I elsewhere mentionte bodies, upon whose putting together numerous bubbles would, for a long time, and not without noise, be gene rated, and succeed one another though I could perceive no Heat a all to accompany this Tumult.

As for the Tast, which by manying made a great Touchstone, whereby to know Acids and Alcalies, I consider that there is a multitude of mixt be dies, wherein we can so little distens by the Tast, which of the Principles is Predominant, that this Sense would not oblige one to suspect, much less to conclude, there were one grain of the there of them to be found there; such bodies are Diamonds and Rubies, and

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most Gems, besides many ignobler Stones, and Gold and Silver and Mercury, and I know not how many other bodies. On the other fide, there are hodies that abound with Acid or Alcalizat Salts, which either have no Taft, or a quite differing one from that of the Chymical Principle. As though Venice-glass be in great part composed of a fixt Alcali; yet to the Tongue it is insipid, and Crystalls of Lune and of Lead made with Aqua fortis, and containing great store of the Acid particles of the Menstruum, have nothing of Acidity in the mouth, the latter having a faccharine fweetness, and the former an extream bitterres. And even in Vegetable subfances that have a manifest Tast, 'tis not so easie to know by that, whether kbe the Acid or the Alcalizat Principle that is predominant in them ; as in the Essential oils of Spices and other Vegetables. And in the gross Empereumatical Oils of Woods, and even in high Rectified Spirit of Wine, which B 2

20 Reflections upon the hypothetic which therefore some will have to an Alcalizat liquor, and others life among Acids, though I did not find neither to be destroyed or much tered by being put upon Coral or is of Tartar, as would happen to an aci Menstruum, nor yet by being digelte with and distilled from sea Salt, a might be probably expected from Alcalizat one: Aand among those ver bodies which their Tasts perswant Chymists to reckon amongst Acids, on may (according to what I former noted) observe so great a different and variety of relishes, that, perhan without being too fevere, I may far. that if I were to allow Acids tok One Principle, it should be only in some such Metaphysical sense, as the wherein Air is faid to be One Body though it confist of the associated fluviums of a multitude of Corpufels of very differing Natures, that agree in very little fave in their being mi nute enough to concur to the Com position of a fluid aggregate, confil-· ing

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ing of flying parts. But having dwelt longer than Nintended on One Objection, tis time that I proceed to those that remain.

CHAP. V.

Nother particular, I am unsatis-A fied with in the Hypothesis of Alcali and Acidum, is, that 'tis in divers cases either needless or useless to explain the Phenomena of Qualities, there being several of these producod,destroyed, or altered, where there does not appear any accession, recess, or change of either of those two Principles; as when fluid water by hard beating is turn'd into confistent froth, and when transparent red Conal is, barely by being beaten and fifted finely, changed into a white and opacous powder; and as when a very flexible piece of fine filver being hammer'd is brought to have a brisk pring, and after a while will, instead B 2

of continuing malleable, crack or cleave under the hammer; and as when (to dispatch and omit otherinstances) a sufficiently thin leaf of Gold, held between the Light and the

Eye, appears green.

Another thing (of kin to the for mer,) that I like not in the Dodring of Acidum and Alcali, is, that though the Patrons of it, whilest they would feem to constitute but two Principles are fain(as I lately intimated) to make I know not how many differing form of Acids, besides some variety of Alcalies; yet their Principles are tooky and narrow to afford any fatisfactory explication of the Phanomena. I fear, cwill be very difficult for them to give a Rational Account of Gravity, Springiness, Light, and Emphatical Colours, Sounds, and some other Qualities that are wont to be called manifest; and much more of several that are confest to be occult, as Ele Aricity, and Magnetism; in which last I see not, how the affirming that there

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there is in the Magnet an Acid and an Alcali, and that these two are of contrary Natures, will help to explain, how a Load-stone does, as they speak, attract the same end of a poised needle with one of its Poles, which will drive away with the other, and determine that needle when freely placed to point North and South, and enable it to communicate by its bare much the same Properties, and abundance of other strange ones, to another piece of Steel. But I forbear to alledge particular Examples referrate to the several Qualities abovementioned, whether manifest or hidden, because that in great part is already done in our Notes about particular Qualities, in which 'twill appear how little able the employing of Alcali and Acidum will be to afford us an account of many things. And though enlarge not here on this objection, yet I take it to be of that importance, that, though there were no other, this were enough to shew that B 4 the

24 Reflections upon the Pypothelis the Hypothesis that is liable toit, Insufficient for the explication of Qualities; and therefore 'twill not presume be thought strange that add that, as for those that would extend this narrow Chymical Dodring to the whole object of Natural Philo fophy, they must do more than lespect they will be able before they can make me their Profelyte, therebeing a multitude of Phenomena in nature (divers whereof I elsewhere takeno tice of in reference to the Chymile Philosophy) in which what Acidna and Alcali have to do, I confess to not understand.

CHAP.

CHAP. VI.

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THE last thing (which comprizes several others) that seems to me a defect in the Doctrine of Alcali and Acidum, is, that divers if not most of those very things that are pretended to be explicated by them, are not satisfactorily explicated, some things being taken into the explications that are either not fundamental enough or not clearly intelligible, or are chargeable with both those Impersections.

And first I am dissatisfied with the very sundamental Notion of this Doctrine, namely a supposed Hostility between the tribe of Acids and that of Alkalies, accompanied, if you will have it so, with a friendship or sympathy with bodies belonging to the same tribe or Family. For I look upon Amity and Enmity as Affections of Intelligent Beings, and I have

not

26 Reflections upon the Pypothetic not yet found it explained by am how those Appetites can be place in Bodies Inanimate and devoid knowledge, or of so much as Sense And I elfewhere endeavour to her that what is called Sympathy and Antipathy between such bodies does in great part depend upon the acting of our own Intellect, which, supposing in every body an innate appetite to preserve it self both in a defensive and an offensive way, inclines us to conclude, that that body, which, though delignelly destroys or impairs the state or texture of another body, bas an Enmity to it, though perhaps a flight Mechanical change may make bodys, that feem extreamly hostile, feem to agree very well and cooperate to the production of the same effects. As if the acid spirit of Salt and the volatile Alkali (as they will have it) that is commonly called Spirit of Urine be put together, they will, after a fhort though fierce conflict, upon a new contexture unite together

gether into a Salt, little, if at all, differing from Sal Armoniac, in which the two reconciled Principles will amicaby join in cooling of water, dissolving some metalline bodys, and produing divers other effects. And so, if upon a strong folution of Salt of Potthesor of Salt of Tartar, good Spirit of Nitre be dropt in a due proportion, after the Heat and Tumult and Ebullition are over, the Acid and the Alkalizat Salts will convene into such a Concretion as Salt-peter, which is taken to be a natural body, either homogeneous, or at least confisting of parts that agree very friendly together, and conspire to constitute the particular kind of Salt that Chymifts call Nitre.

But the Sympathy and Antipathy that is said to be betwixt Inanimate bodys, I elsewhere more particularly consider, and therefore I shall now add in the second place, That the Explications made of Phenomena according to the Doctrine of Alcaliand

28 Reflections upon the Pypothen and Acidum do not, in my apprehent on, perform what may be justlyer pected from Philosophical Explication ons. Tis said indeed, that the Aciden working on the Alcali, or this upo that, produces the effect propoled but that is only to tell us, what isthe Agent that operates, and not the Manner of the operation, or the mean and process whereby it producesthe effect proposed, and 'tis this mode that Inquisitive Naturalists chiefe desire to learn. And if it be said that it is by the mutual hostility of the Principles that the effect is produced it may be answered, that besides, that that hostility it self is not, as we have just now observed, a thing clear, is to mucha s Intelligible; this is so general and indeterminate a way of explicating things, as can afford little or m · satisfaction to a searching and cautious Naturalist, that considers how very numerous and very various the Phanomena of Qualities are.

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CHAP. VII.

O clear up and to countenance what I have been now faying, I hall only take notice of some few obvious Phanomena of one of the most familiar Operations wherein Acidum and Alcali are supposed to be the grand Agents. 'Tis known to the very Boys of Chymists, that Aqua Regis will dissolve Gold, Copper, and Mercury, and that with these metals, especially with the second, it will produce an intense degree of heat. If now the Cause of this Heat be demanded, it may be expeded, that the Patrons of the Duellists will answer, that 'tis from the action of the Acid Salts of the Menstruum upon the Alcali they meet with in the Metalls. But not to mention how many things are here presumed, not proved; nor that I know some Acid Menstruums, and fome

30 Reflections upon the Pypoths fome much more evidently Alak zate Bodys than these Metals at which yet do not upon their mi tures produce any sensible heat; no I fay, to mention thefe, it is eafen difcern, that this answer names is deed two supposed efficients of Hea but does not explicate or deda how these Agents produce that Qu lity, which depends upon a certain vehement and various agitation the fingly insensible parts of Body, whether the Duellists, or any other though very differing, Causes pu them into a motion fo modified And therefore Gold and Copperly bare Concustion may be brought an intense degree of heat without the accession of any acid parts h work upon them. But then fur ther, when we are told, that dan Regis by its Acidity working on the Metalline Alcali makes a diffolution of the Metal; I am told indeed what they think to be the Agenti this change, but not at all fatisfied how

how this Agent effects it; for, Copper being a very hard metal, and Gold generally esteemed by Chymilts the closest and compactest Body in nature, I would gladly know, by what power and way such weak and probably either brittle or flexblebodys as acid Salts, are enabled with that force to disjoin such solid and closely coherent Corpuscles as make up the visible masses of Copper and Gold, nay, and scatter them with that violence as perhaps to toss up multitudes of them into the air. And fince in the diffolution of these Metals there is another Phænomenon to be accounted for, as well as the forcing of the parts asunder, namely the sustentation of the Metal in the Menstruum, the Chymists would have much informed me, if they had well explained, how their Acidum and Alcali is able to sustain and give fluidity to the Corpuscles of the dissolved Metal, which though it be but Cop32 Reflections upon the Pypothelis

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Copper, is nine times as heavy as a bulk of water equal to it, and if it be Gold, is nineteen times heavie than the Liquor that must keep from finking; and at least diven times heavier in specie than the Sala that are mingled with the aqueon parts, can make the Menstruum com posed of them both. Whereas Tril has affured me, that, if a piece of Wax or any other fuch matter be made by less than the hundredth part heavier than an equal bulkd Water, it will, when thoroughly immersed, fall to the bottom and ref there. I might also ask a further Question about these Diffolutions, at why, whereas Aqua Regis dissolve Mercury without being much changed in colour by it, Gold retains its own Citrinity or yellowness in the folvent, and the solution of Copper is of a colour, which being greenile blew is quite differing from that of the metal that affords it, as well as from that of the solvent? And might

might recruit these with other Quenies not impertinent, but that these
may suffice (for a sample) on this
Occasion, and allow me to conclude this Chapter, by representing One thing which I would gladly recommend and inculcate to you,
namely, that Those Hypotheses do
not a little binder the progress of
Humane knowledge that introduce
Morals and Politicks into the Explications of Corporeal Nature,
where all things are indeed transadded according to Laws Mechanital.

C CHAP.

34 Reflections upon the Pypothelis

CHAP. VIII.

Might easily have been more or pious in the Instances annext to the foregoing Animadversions, but that, being desirous to be shorts well as clear, I purposely declind to make use of divers others, that seemed proper to be employed, and indeed might safely enough have been so, because those I have mor tioned, and especially those, (which make a great part of them) that are Mechanical, are not liable to the same exceptions, that I foresaw might be made to elude the force of the Examples I passed by. And though I think I could very well make those foreseen Objections appear groundless or unsatisfactory yet that could scarce be done with out engaging in Controversies that o would prove more tedious than I judged them necessary. And

And yet, although what I have aid in this Excursion be but a part of what I could fay, I would not be thought to have forgot what I intimated at the beginning of it. for though the Reasons I alledged keep me from acquiescing in the Doctrine of Alcali and Acidum, as his proposed under the notion of a Philosophical Hypothesis, such as the Cartelian or Epicurean, which are ach of them alledged by their embracers to be Mechanical, and of a very Catholick extent; yet I deny not that the Consideration of the Duellists (or the two jarring Principles of Alcali and Acidum) may be of good use to Spagyrists and Physitians, as I elsewhere further declare. Nor do I pretend by the past discourse that questions one Doctrine of the Chymists, to beget a general contempt of their Notions, and much less of their Experi-For the operations of Chymiltry may be misapplied by the erroneous

36 Reflections upon the hypothetis roneous Reasonings of the Artille the without ceasing to be themselve things of great use, as being applications of great use, as being applications of great uses as being applications. cable as well to the Discovery of Confirmation of folid Theories, the production of new Phanomens, and beneficial effects. And though I think, that many Notions of Pare celfus and Helmont and fome other Eminent Spagyrifts are unfolid, and not worthy the veneration that their Admirers cherish for them; yet di vers of the Experiments, which el ther are alledged to favour the notions, or on other accounts are to be met with among the followers of these men, deserve the curiosity if not the esteem of the Industriousle quirers into Natures Mysteries And looking upon Chymistry in gross as a Discipline subordinate to Physiques, even Mechanical Philo fophers may justly, in my opinion, think favourably of it, fince, what ever Imperfections, or, if they please, Extravagancies there may be in the

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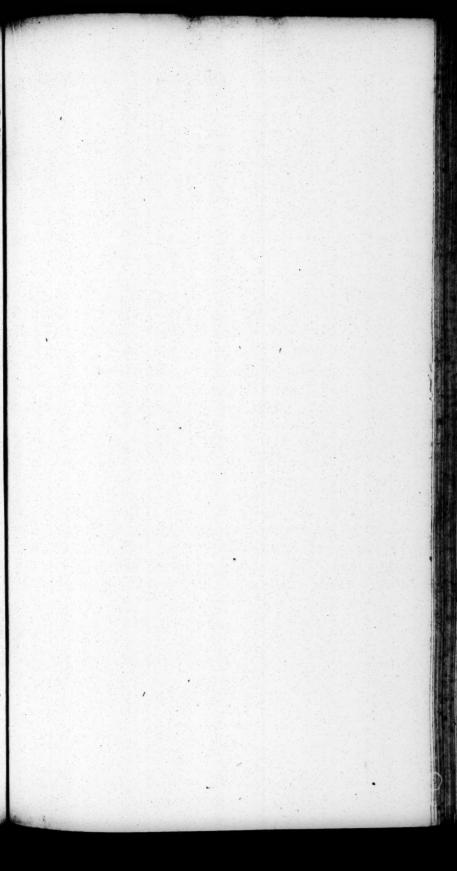
the Principles and Explications of paracels or other Leading Artists, these faults of the Theorical part may be sufficiently compensated by the Utilities that may be derived from the Practical part. And this I am the rather induced to say, because the Experiments, that Chymistry surnishes, may much assist a Naturalist to rectifie the Erroneous Theories that oftentimes accompany Them, and even those (Mistakes) that are endeavour'd to be evinced by them.

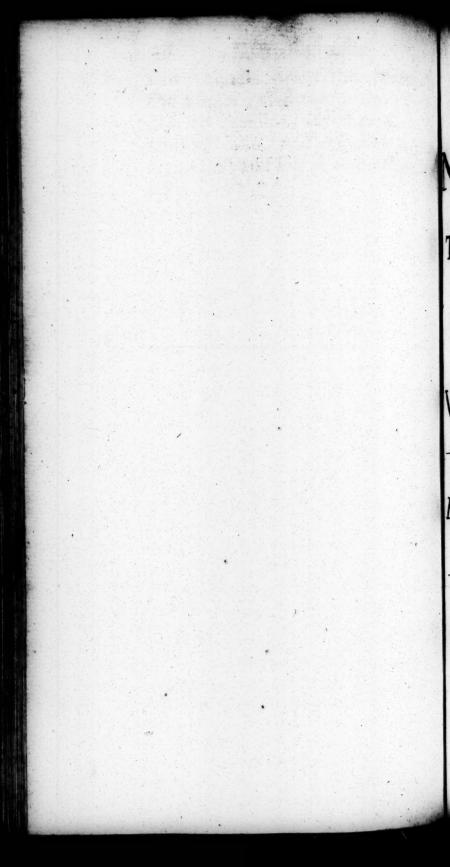
And (to conclude) Chymistry seems to deal with men in reference to Notions, as it does in reference to Metals, assisting wary men to detect the Errors, unto which it may have misled the unwary: For the same Art that has taught some to impose on or thers, (and perhaps themselves first) by blanching Copper, imitating, Gold, &c. does also supply Say-masters and

38 Reflections,&cc.

and Refiners, with the Means, by the Cupel, Cements, Aqua fortin, &c. to examine, whether Coins by true or false, and discover Adulte rate Gold and Silver to be Counterfeit.

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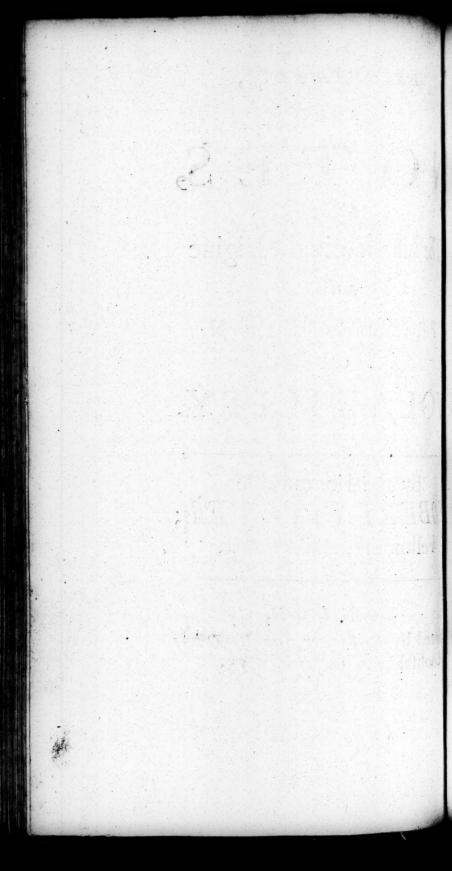
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NOTES

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Qualities.

When, after I had gone through the common Operations of Chymistry, I began to make some serious Reslections on them, I thought 'twas pity, that Instruments that might prove so serviceable to the advancement of Natural Philosophy, should not be more studiously and skilfully made use of to so good a pur-

a purpose. I saw indeed, that diver of the Chymists had by a diligent and laudable employment of their pains and industry, obtain'd diven Productions, and lighted on seven Phænomena confiderable in the kind, and indeed more numerous than, the narrowness and sterility of their Principles consider'd, could well be expected. But I observed too, that the generality of thosethat busie themselves about Chymical 0. perations; some because they pradise Physick; and others because they either much wanted, or gree dily coveted money, aimed in their Trials but at the Preparation of good Medicines for the humane be dy, or to discover the ways of a ring the Diseases or Impersectionsol Metals, without referring their Tr als to the advancement of Natural Philosophy in general; of which most of the Alchymists seem to have been so incurious, that not onely they did not institute Experiment

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for that purpose, but overlookt and despis'd those undesign'd ones that occurr'd to them whilst they were profecuting a preparation of a Medicine, or a Transmutation of Meals. The fense I had of this too general omission of the Chymiss, tempted me sometimes to try, whether could do any thing towards the repairing of it by handling Chymistry, not as a Physician, or an Alchymist, but as a meer Naturalist, and so by applying Chymical Operations Philosophical purposes. And pursuance of these thoughts, I remember I drew up a Scheme of what lventur'd to call a Chymia Philosophica, not out of any affectation of s splendid Title, but to intimate, that the Chymical Operations, there treated of, were not directed to the usual scopes of Physicians, or Transmuters of Metals, but partly to illustrate or confirm some Philosophial Theories by such Operations; and partly to explicate those Operations

tions by the help of such Theories.

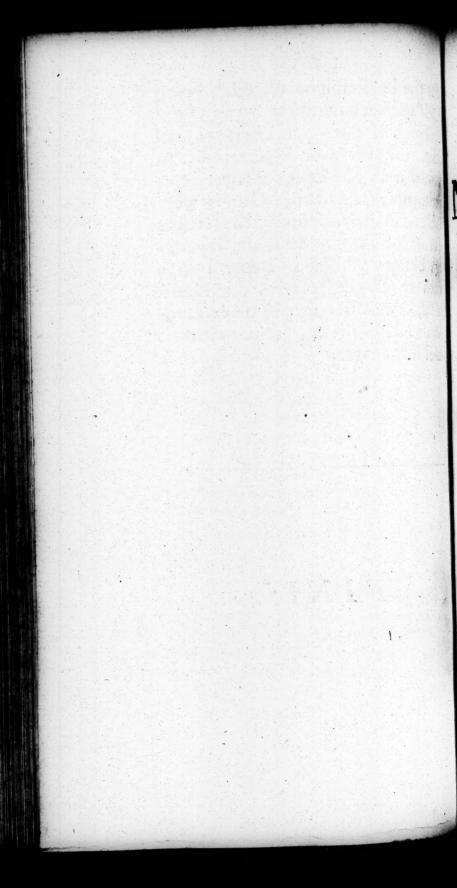
But before I had made any great progress in the pursuit of this de fign, the fatal Pestilence that raged in London, and in many other partsol England, in the years 1664 and 65 obliging me among the rest to make feveral removes; which put me upon taking new measures, and engaging other employments of my time, made me so long negled the Papers I had drawn up, that at lat! knew not where to finde them, (though I hope they are not yet millaid beyond recovery,) which! was the less troubled at, becausethe great difficulties, to be met with in fuch an undertaking, did not a little discourage me, such a Task requiring as well as deferving a Person better furnished, than I had reason to think my felf, with Abilities, Ler fure, Chymical Experiments, and Conveniences, totry as many more as should appear needful. But yet to

to break the Ice for any that may hereafter think fit to fet upon fuch a Work, or to shorten my own Labour, if I should see cause to resume it my felf, I was content to throw in among my Notes about other Particular Qualities, some Experiments and Observations about some of those, that I have elsewhere call'd Chymical Qualities, because 'cischiefly by the Operations of Chymists, that men have been induced to take special notice of them. Of these Notes I have affigned to some Qualities more, and to some fewer, as either the nature or importance of the Subject seemed to require, or my Leisure and other Circumstances would permit. And though I have not here handled the Subjects they belonged to, as if I intended such a Chymia Philosophica as I lately mentioned, because my design did not make it necessary, but did perhaps make it impertinent for me to do fo, yet in some of the larger Notes

Notes about Volatility and Fixtness, and especially about Precipitation, have given some little specimens of the Theorical part of a Philosophi cal Account of those Qualities or Operations, that I hope will not be wholly useless. I know, it may be objected, that I should have employ. ed for Instances some more considerable Experiments, if not Arcana; but though possibly I am not altogether unfurnished with such, yet aiming rather to promote Philosophy, than appear a Possessor of elaborate Processes, I declined several Experiments that required either more skill, or more time, or more expence than could be well expeded from most Readers, and chose rather to employ such Experiments as may be more easily or cheaply tried, and, which is mainly to be consider'd, being more simple, are more clearly intelligible, and more fit to have Notions and Theories built upon them; especially considering, that

that the Doctrine of Qualities being it self conversant about some of the Rudimental parts, if I may so call them, of Natural Philosophy, it seemed unsit to employ intricate Experiments, and whose Causes were lable to many disputes, to settle a Theory of them. In short, my defign being to hold a Taper not so much to Chymists as to the Naturalists, 'twas sit I should be less solicitous to gratisse the former than to inform the later.

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EXPERIMENTS.

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CHAP. I.

S far as I have yet observed, the Qualifications or Attributes, on whose account a portion ofmatter is found to be Volatile, are thiefly four; whereof the three former most regard the single Corpuscles A 2 88

4 Df the Bethanical Dzigine as such; and the last, the manner of their Union in the aggregate or bo

dy they make up.

But before I enter upon partinlars, give me leave to advertise you here once for all, That in the follow ing Notes about Volatility and Fixe ness, when I speak of the Corpusch or minute parts of a body, I doe not mean strictly either the Elementary parts, such as Earth and Water, or the Hypostatical Principles, such as Salt, Sulphur, or Mercury; forthele things come not here into consideration: But onely fuch Corpucks, whether of a simple, compounded or decompounded Nature, as havethe particles they confift of fo firmly united, that they will not be totally di joyned or diffipated by that degree of Fire or Heat, wherein the matter is said to be volatile or to be fin But these combined particles will in their aggregate either ascend, or continue unraised per modum Unius (8 they speak) or as one intire Corpuscle. As in a Corpuscle of Sal Armoniac,

and Production of Holatility.

rof piac, whether it be a natural or facbo inious thing, or whether it be perfelly similar, or compounded of differing parts, I look upon the intire icu-Corpuscle as a volatile portion of you matter; and so I doe on a Corpuscle)Wof Sulphur, though experience shews when 'tis kindled, that it has great fore of acid Salt in it, but which is not extricated by bare sublimation: And so Colcothar of Vitriol falls under our consideration as a fixt body, without inquiring what cupreous or other mineral and not totally fixt parts may be united with the Earthly ones; fince the fires, we expose it to, do not separate them.

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And this being premised in the general, I now proceed to some particulars. And first to make a volatile body, the parts should be very small. For, cateris paribus, those that are so, are more easily put into motion by the action of the fire and other Agents, and consequently more apt to be elevated, when, by the determination of the movent, the situation

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wrought on, either by the air agin ted by the fire, or by the effluviad kindled fuell, or by the impulsed the shaken Corpuscles of the bodyi felf, will much facilitate the elevation of such a minute particle, by er poling a greater portion of it to the action of the agent, as it will often times also facilitate the renewed for stentation of such a small body in the

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air, which relists more the descent of particles whole furfaces are large, than of others of the same gravity nd bulk : As a leaf of paper displayd will much longer hover in the Air, than if it were reduced into a bill or pellet. That this minuteness of particles may dispose them to be arried upwards, by the impulse of other bodies and that of the agitated Air, is very obvious to be observed: As we fee, that Horfes in a high-way, though they be not able with the hakes of their feet to make stones, or gravel, or clods of Earth fly up, yet they will easily raise clouds of dult oftentimes mingled with the faller grains of fand. And where Timber is fawing, the fame wind that will not in the least move the beams, and scarce at all move the chips, will cally carry up the Saw-dust into the Air. And we see in our Chimneys, that the smoak readily ascends, whilst even small clods of soot, which is but maggregate of the particles of smoak, fill headlong down.

A 4 CHAP.

CHAP. II.

THE next qualification requifit in the corpufcles of Volatile bodies is, that they be not too low or heavy. For if they be so, thous their bulk be very small, yet, unle other Circumstances do much conpensate their weight, 'twill be ven difficult to elevate them, becaused the great disproportion of their specific gravity to that of the Au (which contributes to sustain and ven raise many sorts of volatile parts and to the strength of the igneous effluvia or other agents that would carry them up. Thus we fee, the filings of Lead or Iron, and eva Minium (which is the calx of Lead) though the grains they consist of a very small, will not easily be blom up like common dust, or meal, or o ther powders made of less ponderou materials.

A third Qualification to be defined in the corpuscles that should make

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and Production of Aolatility. 9 up a Volatile body is, that they be conveniently shaped for motion. For ifthey be of branched, hook'd, or other very irregular or inconvenient figures, they will be apt to be stopt and detained by other bodies, or enungled among themselves, and conlequently very difficult to be carried upwards, in regard that, whilft they are thus fastened either to one another, or to any stable body, each ingle Corpuscle is not onely to be considered, as having its own pecuhar bulk, fince its cohesion with the other corpuscle or body that detains it, makes them fit to be look'd upon on modum Unius; that degree of hat they are exposed to being prefimed uncapable of disjoyning them. And this may be one Reason, why Water, though it be specifically heavier than Oil, yet is much more easily brought to exhale in the form of vapours than is Oil, whose corpuscles by the lasting stains they leave on cloath, wood, wool, &c. (which wato will but transiently moisten, not Stain) 10 Df the Mechanical Dzigine stain) seems to be of very intangling

figures.

The fourth and last qualification requisite in a Volatile body is, that the parts do loosely adhere, or a least be united in such a manner, a does not much indispose them to be separated by the fire in the formal

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fumes or vapours.

For he that considers the matter will easily grant, that, if the conterture of the corpuscles, whereof aledy consists, be intricate, or their hesion strong, their mutual implication, or their adherence to each ther, will make one part hinder ao ther from flying separately away, and their conjunction will make themw heavy or unweildy to be elevated gether, as intire though compounded Thus we see, that in Spring or the beginning of Summer, a wind though not faint, is unable to cam off the lightest leaves of trees, b cause they stick fast to the bows and twigs on which they grow, but in Autumn, when that adhesion ceales,

and Production of Tolatility. 11 and the leaves fit but loofely on, a wind no stronger than that they refifted before, will with ease blow them off, and perhaps carry them up a good way into the Air. But here note, that it was not without some cause, that I added above, that in a fuid body, the parts should at least be united in such a manner, as does not much indispose them to be sepanted. For 'tis not impossible, that the parts of a body may, by the figures and smoothness of the surfaces, be sufficiently apt to be put into motion, and yet be indisposed to admit such a motion as would totally sepante them and make them fly up into the Air. As, if you take two pieces ofvery flat and well-polished marble or glass, and lay them one upon the other, you easily make them slide along each others furfaces, but not eafily pull up one of them, whilest the other continues its station. when Glass is in the state of fusion, the parts of it will eafily slide along each other, (as is usual in those of other

1'2 Df the Wechanical Dzigine ther fluids) and consequently change places, and yet the continuity of the whole is not intirely broken, but every corpuscle does somewhat touch some other corpuscle, and thereby maintain the cohesion that indisposes it for that intire separation accompanied with a motion upward that we call avolation. when Salt-peter alone, is in a Cruci ble exposed to the fire, thoughave ry moderate degree of it will suffice to bring the Salt to a state of fusion, and consequently to put the corps scles that compose it into a restles motion; yet a greater degree of het, than is necessary to melt it, will m extricate fo much as the Spirits, and make them fly away.

CHAP. III.

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HE foregoing Doctrine of the Volatility of bodies may be as well illustrated as applied, if w proceed to deduce from it the generall

and Production of Cholatility. 13
mill ways of Volatilization of bodies, or of introducing volatility into an affigued portion of matter. For these wayes seem not inconveniently reducible to five, which I shall severally mention, though Nature and Art do usually imploy two or more of them in conjunction. For which Reason I would not, when I speak of one of these wayes, be understood as if, excluding the rest, I meant that no other concurred with it.

The first of the five ways or means of Volatilizing a body is, to reduce it into minute parts, and, cateris paribus, the more minute they are the better.

That the bringing a body into very minute parts may much conduce to the volatilizing of it, may be gathered from the vulgar practice of the Chymists, who when they would sublime or distill Antimony, Sal Armoniac, Sea-salt, Nitre, &c. are wont to beat them to powders to faditate their receiving a further commution by the action of the fire.

And

14 Of the Wechanical Dzigine And here I observe, that in someh dies this comminution ought not h be made onely at first, but to be con tinued afterwards. For Chymists by experience, though perhaps with out confidering the reason of it, the Sea-salt and Nitre, will very hard afford their Spirits in Distillation, without they be mingled with por dered clay or bole, or fome fuch ther additament, which usually twin or thrice exceeds the weight of the Salt it self: Although these adding ments, being themselves fixt, seen unlikely to promote the volatilization of the bodies mixt with them. yet by hindering the small grains of Salt to melt together into one lun or masse, and consequently by keep ing them in the state of Comminut on, they much conduce to the driving up of the Spirits or the finer parts of the Salts by the operation of the

But to profecute a little what I was saying of the Conduciveness to bringing a body into small parts to

fire.

and Production of Aclatility. 15 the volatilization of it, I shall adds that in some cases the Comminution may be much promoted by employing Physical, after Mechanical, ways; and that, when the parts are brought which a pitch of exiguity, they may belevated much better than before. Thus, if you take filings of Mars, and mix them with Sal Armoniack, some few parts may be sublimed; but if, s I have done, you dissolve those filings in good Spirit of Salt instead of Oil of Vitriol, and having coagulated the folution, you calcine the greenih Crystalls or vitriolum Martis that will be afforded, you may with ease, and in no long time, obtain a Crocus Mutis of very fine parts; so that I member, when we exquisitely mingled this very fixt powder with a convenient proportion of Sal Armoviac, and gradually press'd it with a competent fire, we were able to elevate at the first Sublimation a confidetable part of it; and adding a like, or somewhat inferiour, proportion of fielh Sal Armoniac to the Caput Mortuum.

tuum, we could raise so considerable a part of that also, and in it of the Crocus, that we thought, if we had had Conveniency to pursue the operation, we should, by not many repeated Sublimations, have elevated the whole Crocus, which (to hint the upon the by,) afforded a Sublimator so very astringent a Tast, as my make the trial of it in stanching of blood, stopping of sluxes, and other cases, where potent astriction is defired, worthy of a Physicians Curio sity.

CHAP. IV.

THE second means to volatilize bodies is, to rub, grind, or of therwise reduce their corpuscles to be either smooth, or otherwise stay shaped to clear themselves, or be distintangled from each other.

By reason of the minuteness of the corpuscles, which keeps them from being separately discernible by the Eye,

and Production of Aclatility. 17 ble Eye, 'tis not to be expected, that imthe mediate and ocular Instances should had be given on this occasion; but that he heha change is to be admitted in the mall parts of many bodies, brought tel nbe volatile, seems highly probahe from the account formerly given of of the requisites or conditions of Voatility, whose introduction into a portion of matter will scarce be exof olicated without the intervention of er ich a change. To this second Instrue. ment of Volatilization, in concurrence with the first, may probably bereferred the following Phanomem: In the two first of which there simployed no additional volatile Ingredient; and in the fourth, a fixt body is disposed to volatility by the operation of a Liquour, though this becarefully abstracted from it. I. If Urine freshly made be put to

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dil, the Phlegm will first ascend, and the Volatile falt will not rise 'till that be almost totally driven away, and then requires a not inconsiderable degree of fire to elevate it. But,

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one another, that the finer ones of the Salt will perhaps be made nor flender and light, and however will be made to extricate themselves for a sto become volatile, and, a scending in a very gentle heat, lear the greatest part of the phlegmbe hind them.

of Grapes, be distilled before it have been fermented, 'tis observed by Chymists, and we have tried the like in artificial Wine made of Raison, that the phlegm, but no ardent Spirit, will ascend. But when this Liquor is reduced to Wine by fermentation, which is accompanied with a great and intestine commotion of the jubling parts, hitting and rubbing against one another, whereby some probably come to be broken, others to be variously ground and subsilized, the

and Production of Wolatility. 19 more subtile parts of the Liquour being extricated, or some of the parts being, by these operations, brought to be subtile, they are qualified to he raised by a very gentle heat before the phlegm, and convene into hat fugitive Liquour, that Chymists, for its activity, call Spirit of Wine. Nor is it onely in the flighter Instance afforded by Animals and Vegetables, that Volatility may be effected by the means lately mentioned: For experience hath affured me, that 'tis polible, by an artificial and long digeltion, wherein the parts have leihire for frequent justlings and attritions, so to subtilize and dispose the orpuscles even of common Salt for Volatility, that we could make them ascend in a moderate fire of Sand without the help of Bole, Oil of Vitriol, or any Volatilizing additament; at and, which is more confiderable, the Spirit would in rifing precede the Phlegm, and leave the greatest part thereof behind it.

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20 Df the Wechanical Dzigine capable of producing Volatility in the more disposed portions of a body, though it be much more easie to be found in Liquours, or in moist and fost bodies, yet I have sometimes, though rarely, met with it in dry ones. And particularly I remember, that some years ago having, for til fake, taken Mustard-seed, which is body pregnant with subtile parts, and caused it to be distilled per se in a Re tort, I had, as I hoped, (without any more ado,) a great many grains of clear and figured Volatile falt at the very first distillation : which Experiment having, for the greater fearity, made a second time with the like fuccess, I mentioned it to some lo vers of Chymistry, as what I just supposed they had not heard of. I leave it to farther Inquiry, whether, in a body so full of Spirits as Mustard feed, the action and re-action of the parts among themselves, perhaps pro moted by just degrees of fire, might not suffice to make in them a change equivalent in order to Volatilization, and

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and Production of Holatility. and the yielding a Volatile Salt, to hat which we have observed Fermenmion and Putrefaction to have made the juice of Grapes, Urine, and ome other bodies. How far the like ficcels may be expected in other Trialls, I cannot tell; especially not haring by me any Notes of the events offome Attempts which that Inquiry outme upon: Onely I remember in general, that, as some trials, I made with other Seeds, and even with Amatick ones, did not afford me any Volatile Salt; so the success of other mials made me now and then think, that some subjects of the Vegetable kingdom, whence we are wont to drive over acid Spirits, but no dry Salt, may be distilled with so luckily regulated a heat, as to afford something, though but little, of Volatile salt; and that perhaps more bodies would be found to doe fo, were they not too hastily or violently prest by the fire, whereby such saline schenatisms of the desired parts of the natter are (by being distipated or B 3 con22 Of the Wechanical Drigine confounded) destroyed or vitiated, tals as in a flow, dextrous, or fortunate to way of management would com life forth, not in a liquid, but a falle on Of which Observation we of may elsewhere mention some Instantin ces, and shall before the close of the Paper name one afforded us by crude II Tartar.

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3. Though Silver be one of the pe fixedst bodies that we know of, ye that 'tis not impossible but that, chief & ly by a change of Texture, it my strangely be disposed to Volatility, was induced to think by what Ire member once happened to me A Gentleman of my acquaintance, fludious of Chymical Arcana, having lighted on a strange Menstrum, which he affirmed, and I had foot cause to believe, not to be corrosive, he abstracted it from several metally (for the same Liquour would serve again and again,) and brought meth Remainders, with a desire that would endeavour to reduce those d Lead and Silver into the pristine me tals

and Production of Avlatility. 23

las again, which he had in vain atempted to doe; whereupon, though found the white Calx of Lead remible, yet when I came to the Calx Silver, I was not able to bring it into a body; and having at length elted some Lead in a gentle fire, to whether I could make it swallow wthe Calx, in order to a farther operation, I was not a little surprized wind, that this mild heat made the talk of Silver presently fly away and iblime in the form of a farina volatiin, which whitened the neighbouring put of the Chimney, as well as the upper part of the Crucible.

thenselves tell us, I think we may draw a good Argument ad hominem, to prove, that Volatility depends much upon the texture and other Mechanical affections of a body. For divers of those Hermetick Philosophers (as they are called) that write of the Elixir, tell us, that when their Philosophick Mercury or grand Solment, being sealed up together with a

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24 Of the Mechanical Dzigine third or fourth part of Gold in a glass is Egg, is kept in convenient degrees of on fire, the whole matter, and confe Th quently the Gold, will, by the mut. is al operation of the included Substant ces, be fo changed, that not onely in twill circulate up and down in the bu glass, but, in case the digestion orde in coction should be broken off at ace. cu tain inconvenient time, the Gold or would be quite spoil'd, being, by the in past and untimely-ended operation, made too Volatile to be reducible ! i gain into Gold: whereas, if the deco. tion be duly continued unto the end, the not onely the Gold, but all the Philo- It sophical Mercury or Menstruum will be turned into a Sulphur or powder of a wonderfully fixt nature. I know, there are several Chrysopæans, that speak much otherwise of this Opera to tion, and tell us, that the Goldin I ployed about it must be Philosophia I Gold: But I know too, that there is are divers others (and those toonon of the least candid or rational) that speak of it as I have done; and That

and Production of Aslatility. 25 sufficient to ground an Argument n towards all those that embrace Their doctrine. And in this case is considerable, that 'tis not by any iperadded additament, that the most in body of Gold is made volatile, but the same massy matter, consihing of Gold and Philosophick Merary, is, by the change of texture produced or occasioned by the vanous degrees and operations of fire monit, brought to be first Volatile, and then extreamly fixt. And having hid this in reference to one tribe of the Modern Spagyrists; to another of them, the Helmontians, I think I can ofer a good Argument ad hominem from the Testimony and Experiments of the Founder of their Sect.

5. The acute Helmont, among other prodigious powers that he afribes to the Alkahest, affirms, that, by abstracting it frequently enough, it would so change all tangible bodies, and consequently stones and metals, that they might be distilled over into Liquours equiponderant

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and Production of Colatility. 27

CHAP. V.

HE fourth means of making a body Volatile is, by affociaing the particles to be raised with fich as are more Volatile than them-Aves, and of a figure fit to be fastened in them, or are at least apt, by being added to them, to make up with them corpuscles more disposed than they to Volatility. This being the gand Instrument of Volatilization, Islall spend somewhat the more time bout it : But I shall first here a little eplain the last clause, (that I may not brobliged to resume it elsewhere,) by mimating, that 'tis not impossible, that the particles of an additament, though not more volatile than those of the body 'tis mixt with, and perhaps though not volatile at all, will In conduce to volatilize the body wherewith 'tis mingled. For the particles of the additament may be of hich figures, and so affociated with hose of the body to be elevated,

28 Df the Wechanical Dzigine as in this to enlarge the former pores, or produce new ones, by intercepting little cavities (for they must not be great ones) between the particles of a body to be raised, and those of the additament. For, by these and other such ways of association, the corpuscles, resulting from the combination or coalition of two or more of these differing particles, may, without becoming too big and unwieldy, become more conveniently shaped, or more light in proportion their bulk, and so more easily buoyed up and sustained in the air, (as when the Lid of a Copper-box being put on, makes the whole box emerge and fwim in water, because of the intercepted cavity, though neither of the parts of the box would doe fo,) or otherwise more fitted for avolation than the particles themfelves were before their being joined to those of the additament.

By two things chiefly the corpufcles of the additament may contribute to the elevation of a body. For

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and Production of Colatility. 29 fif, the parts of the former may be much more disposed for avolation han is necessary to their own Volaility. As when in the making of MArmoniac, the faline particles of Urine and of Soot are more fugitive han they need be to be themselves fiblimed, and thereby are advantaed to carry up with them the more logish corpuscles whereof Sea-salt confifts. And next, they may be of fgures so proper to fasten them well whe body to be elevated, that the more fugitive will not be driven away or disjoyned from the more fixt by such a degree of Heat as is sufficiento raise them both together: To which effect the congruity or figuration is as well required, as the lightnels or volatility of the particles of the additament. And therefore some of the fugitivest bodies that we know, as Spirit of Wine, Camphire, &c. will not volatilize many bodies which will be elevated by ar less sugitive additaments; because the corpuscles of Spirit of Wine stick not

not to those of the body they are mingled with, but, easily flying up themselves, leave those behind them, which they did rather barely touch than firmly adhere to: Whereas far less sugacious Liquours, if they be indowed with figures that set them for a competently firm cohesion with the body they are mingled with, will be able to volatilize it. Of which I shall now give you some Instances in bodies that are very ponderous, or very fixt, or both.

And I shall begin with Colcothar, though it being a vitriolate calx, made by a lasting and vehement fire, 'tis (consequently) capable of resisting This being exquisitely fuch a one. ground with an equal weight of Sil Armoniac, which is it felf a Saltbu moderately volatile, will be in good part sublimed into those yellow Flowers, which we have elsewhere more particularly taught to prepare, under the name of Ens primum Von ris; in which, that many vitriolate corpuscles of the Colcothar are really ele

and Production of Anatility. 31 elevated, you may easily find by puting a grain or two of that reddish substance into a strong infusion of Galls, which will thereby immediate-

racquire an inky colour.

Steel also, which, to deserve that me, must have endured extraordimy violences of the fire, and greater than is needfull to obtain other netalls from their Mother Earth; steel it self, I say, being reduced to sings, and diligently ground with about an equal weight of Sal Armoniac, will, if degrees of fire be skilfully administred, (for 'tis easie to min that point,) without any premous calcination or reduction to a success, suffer so much of the metall to be carried up, as will give the Sal Amoniac a notable colour, and an itonish tast.

And here it will be proper to obleve, for the sake of practical Chymils, that the Quantity or Proportion of the Volatile additament is to be regarded; though not so much as in Nature, yet more than it is wont

32 Df the Wechanical Dzigine to be: And divers bodies, that are thought either altogether unfit for Sublimation, or at least uncapableto have any confiderable portion of them elevated, may be copiously e. nough sublimed, if a greater proportion of the additament, than we usual ly content our felves with, be skilfully imployed. And in the newly-mentioned Instance of Filings of Steel, if, in stead of an equal weight of Sal Armoniac, the treble weight be taken, and the operation be duly managed, a far greater quantity of the metall may be raised, especially if fresh Sal Armoniac be carefully ground with the Caput Mortum. And Sal Armoniac may perhaps be compounded with such other bodies, heavier than it felf, as may qualifieit, when it is thus clogged, to elevate some congruous bodies better than it would of it self alone. shall venture to add this farther Advertisement, That if, besides the plen ty of the additament, there be a fulficient fitness of its particles to lay

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and Production of Molatility. 33 hold on those of the body to be wought on, Mineral bodies, and bole ponderous enough, may be employed to volatilize other heavy bones. And I am apt to think, that alnolt, if not more than almost, all Metalls themselves may by copious aditaments and frequent Cohobatios be brought to pass through the nck of the Retort in distillation; and perhaps, if you melt them not with equal parts, but with many puts of Regulus of Antimony, and then proceed as the hints now given will direct you, you will not find onse to despise what I have been living.

lou know what endeavours have been, and are still fruitlessly, imployed by Chymists to elevate so fixt a body a salt of Tartar by additaments. I hall not now speak much of the enterprize in generall, designing chiefly to tell you on this occasion, that, whereas frequent experience shews, that sal Armoniae being abstracted som salt of Tartar, not onely the

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34 Of the Wechanical Dzigine Salt of Tartar is left at the bottom, but a good part of the Sal Armonia is lest behind with it; I suspected the cause might be, that Sal Armonia, by the operation of the Alkaly of Tartar, is reduced into Sea-salt, and Urinous or fuliginous Salt, as 'twas at first composed of those differing la gredients; and that by this mean the volatil Salt being loofened a disintangled from the rest, and being of a very fugacious Nature, fye eafily away it felf, without staying long enough to take up any other Salt with it. And therefore, if this Analysis of the Sal Armoniac could be prevented, it seemed not imposfible to me, that some part of the Salt of Tartar, as well as of Color thar and Steel, might be carried my by it : And accordingly having canfed the Ingredients to be exceeding well dryed, and both nimbly and care fully mixt, and speedily exposed to the fire, I have sometimes had portion of Salt of Tartar carried m with the Sal Armoniac : but this hap pened

and Production of Holatility. 35 pened so very rarely, that I suspected some peculiar sitness for this work in some parcels of Sal Armoniac, that rescarce but by the effect to be discerned from others. But however, what has happened to us may argue the Possibility of the thing, and may serve to shew the volatilizing efficacy of Sal Armoniac; which is a Compound, that I elsewhere recommend, and doe it now again, as one of the usfullest Productions of vulgar Chymistry.

And since I have mentioned the Volatilization of Salt of Tartar, preiming your Curiosity will make you belie my Opinion about the Possibility of it, I shall propose to you a distinction, that perhaps you doe not upect, by saying, that I think there sagreat deal of difference between the making a Volatile Salt of Tartar, and the making Salt of Tartar Volatile. For, though this seem to be but a Nicety, yet really it is none; and it is very possible, that a man may som Tartar obtain a Volatile salt,

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36 Of the Werhanical Dzigine and yet be no wife able to volatilize that Tartareous Salt, that has been once by the incineration of the Tartar brought to fixt Alkaly. I have in the Sceptical Chymist Summarily delivered a way, by which both i, and some Spagyrists that learned it of me, obtained from a mixture of Antimony, Nitre, and crude Tartar, a Volatil falt, which in probability comes from the last named of those three bodies; but experience care fully made has affured me, that without any additament, by a distillation warily and very flowly made, (infomuch that I have spent near a week in distilling one pound of matter) very clean Tartar, or at least the Crystalls of Tartar, may, in conveniently shaped Vessels, be brought to afford a Substance that in Redification will ascend to the upper part of the Vessel, in the form of a Volatil Salt, as if it were of Urine or of Harts-horne; of which (Tartareous) Salt, I keep some by me: But this operation requires not onely a derterous,

and Production of Holatility. 37 prous, but a patient distiller.

But now as to the making a fixt Alkaly of Tartar become Volatil, I ake it to be another, and have found tobe a far more difficult, work; the mmon Processes of performing it being wont to promise much more han they can make good; which I my justly say of some other, that givate men have vaunted for great heava, but upon triall have satisfied neso little, that I have divers times offered pretenders to make Salt of Tartar Volatil, that without at all iquiring into their Processes, I would ly good wagers, that they could not what they pretended; not onely adivers Philosophical Spagyrists require, without any visible additament, but by any additament whatever; provided I were allowed to bring the Salt of Tartar my felf, and to examine he Success, not by what may appear in the Alembic and Receiver, but by the weight of what would remain the bottom. For I have convinnd some of the more Ingenuous Ar-C 3 tists.

Of the Wechanical Dzigine tifts, that the Salt that sublimed was sel not indeed the Alkaly of Tartar, but somewhat that was by the operation produced, or rather extricated out of the additaments. But yet I would

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not be thought to affirm, that 'tis not possible to elevate the fixt Salt of For sometimes I have been 18 able to doe it, even at the first Di-

stillation, by an artificial additament perhaps more fixt than it felf; but, though the operation was very grate full to me, as it shewed the Possibili-

ty of the thing, yet the paucity of the Salt sublimed and other Circum-

stances, kept me from much valuing it upon any other account. And there are other wayes, whereby Experi-

ence has affured me, that Salt of Tartar may be raised. And if one of them were not so uncertain, that

I can never promise before hand that it will at all succeed, and the other so laborious, difficult and costly, that

few would attempt or be able to practice it, I should think them ve-

Ty valuable things; fince by the for: mer,

and Production of Avlatility. 39 ter way most part of the Salt of fartar was quickly brought over in form of a Liquor, whose piering smell was scarce tolerable; and wthe latter way some Salt of Tarmof my own, being put into a Rem, and urged but with fuch a fire scould be given in a portable Sandimace, there remained not at the bottom near one half of the first right, the additament having caridup the rest, partly in the form of liquor, but chiefly in that of a white Sublimate, which was neither Hented, nor in tast corrosive, or inlizat, but very mild, and somewhat sweetish. And I doe not much bubt, but that by other wayes the m Alkaly of Tartar may be elevatd, especially if, before it be expo-In to the last operation of the fire, the dextroufly freed from the most of those Earthy and Viscous parts, that I think may be justly suspected oclog and bind the truly faline ones. But I have too long digrest, and herefore shall intimate onely upon the

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the by, that even the spurious sale tractari volatilized that is made with Spirit of Vinegar, may, if it be well prepared, make amends for its Empyreumatical smell and tast, and may, notwithstanding them, in diversor see be of no despicable use, both as a Medicine, and a Menstruum.

CHAP. VI.

Before I draw towards a Conclufion of these Notes about Volatility, perhaps it will not be amis,
to take notice of a Phænomenon,
which may much surprise, and sometimes disappoint those that deal in
Sublimations, unless they be fore
warned of it. For though it betaken
for granted, and for the most pan
may justly be so, that by carefully
mingling what is sublimed with what
remains, and re-subliming the minture, a greater quantity of the body to be sublimed may be elevated
the second time than was the first,

and Production of Colatility. 41 the third time than the fecond, dio onwards; yet I have not found Rule alwayes to hold, but in me Bodies, as particularly in some inds of dulcified Colcothar, the Sal Amoniac, would at the first Sublimaincarry up more of the fixed powder, than at the second or third. that I was by several Tryalls per-fraded, when I found a very well ad highly coloured powder elevand, to lay it by for use, and thereby five my felf the labour of a profeution, that would not onely have proved useless, but prejudicial. And il misremember not, by often repated Cohobations, (if I may so call ilem) of Sal Armoniac upon crude a Mineral Antimony, though the sublimate that was obtained by the ful Operation, was much of it varionly, and in some places richly, coloured; yet afterwards, the Salt asended from time to time paler and paler, leaving the Antimony behind ". Which way of making some Minerals more fixt and fulible I conceive

42 Df the Bechanical Digine ceive may be of great use in some Con Medicinal Preparations, though to f think it not fit to particularize then in this place : Where my chief in tent was, to mention the Phanome an non it felf, and invite you to confider, whether it may be ascribed to fre this, that by the reiterated action of the fire, and grinding together of the body to be raised, either the corpufcles of the Sal Armoniac, or thole of the other body, may have those m little hooked or equivalent particle, whereby they take hold of one another, broken or worn off; and whether the indisposedness of the Colcotharine or Antimonial parts to ascend, may not in some cases be promoted by their having, by frequent attritions, so smoothed their Surfaces that 1 divers of them may closely adhere, like pieces of polished Glass, and so make up Clusters too unweildy to be so raised, as the single corpused they consist of, were. Which change may dispose them to be at once les Volatil and more Fusible. Which Con

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Conjectures I mention to excite you of frame better, or at least to make mends for my omission of examining these, by trying whether the Sal amoniac grown white again will be so fit as it was at first to carry up fesh bodies; and also by observing the weight of the unelevated part, and employing those other wayes of examen, which I should have done, if I had not then made Sublimations for another end, than to dear up the Doctrine of Volatility.

And here it may be profitable to lone Chymists, though not necessary may Subject, to intimate, that Sub-limations may be useful to make very fine Comminutions of divers bodies. That those that are elevated are reduced to a great fineness of parts, is obvious to be observed in many Examples, whence it has been anciently, not absurdly, said, that Sublimations are the Chymists Pestles, since (sin Flowers of Sulphur and Anti-mony) they do really resolve the eleva-

44 Df the Wechanical Dzigine |1 elevated bodies into exceeding find Flower, and much finer than Pelile of and Mortars are wont to bring them B to. But that which I intend in this Paragraph is not a thing so obvious in fince 'tis to observe, that sometimes of even bodies fo fixt as not at all to afeend in Sublimation, may yet be read duced by that operation into power ders extreamly fine. For exemplifying of which, I shall put you in mind, that though Spagyrists complain much of the Difficulty of making a good in Calx of Gold, and of the Imperfeation of the few ordinary processes if prescribed to make it, (which would la be more complained of, but that in Chymical Physicians seldom attempt to prepare it,) yet we are informed by triall, that by exactly grinding a thick amalgam of Gold and Mercury with competent weight, (at least equal to its own) of finely powdered Sulphur, we may, by putting the mixture toliblime in a conveniently shaped Glass, by degrees of fire obtain a Cinaber that will leave behind it a finer Calx

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le re difficult processes.

But 'tis now time to draw towards Conclusion of our Notes about Vo-- puscles that are to be raised to-Liner, that even very ponderous mies may serve for volatilizing ad-manents, if they be disposed to fa-mathemselves sufficiently to the bo-in they are to carry up along with m. For, though Lead be, save and though Quick-filver be the wiest body in the world, except bid; yet trialls have affured us, the Quick-filver it felf being united h Amalgamation with a small promin of Lead, will by a fire that inone of the violentest, and in close Veffels, be made to carry over with it me of the Lead. As we clearly found by the increased weight of the Quick-Merthat passed into the Receiver; thich, by the way, may make us autious how we conclude Quickfilver

46 Of the Wechanical Dzigine filver to be pure, meerly from its he

ving been distilled over.

There remains but one bod 61 more heavy than those I come from maming, and that is Gold; which, being also of a fixity so great that 'tising. deed admirable, I doe not wonder that not onely the more wary Name ralists, but the more severe among the Chymists themselves should think it incapable of being volatilized But yet, if we consider, how very minute parts Gold may be rational. ly supposed to consist of, and to be divisible into, me thinks it should no seem impossible, that, if men could light on Volatil Salts endowed with figures fit to flick fast to the corpuscles of the Gold, they would carry up with them bodies, whose solidity can scarce be more extraordinan than their minuteness is : And in de Menstruum, with which some particles of Gold may be carried up. But of Gold may be carried up. But when I employed that which I recommended to you formerly under the Dame

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me of Menstruum peracutum (which milts mainly, and sometimes onely, spirit of Nitre, several times drawn m Butter of Antimony,) I was be, without a very violent fire, in sew hours to elevate so much crude fold, as, in the neck of the Retort, forded me a considerable Quantity sublimate, which I have had red blood, and whose consisting partly sold manifestly appeared by this, but I was able with ease to reduce but metall out of it.

Inreckoning up the Instruments of Valilization, we must not quite lave out the mention of the Air, which I have often observed to facilize the elevation of some bodies can in close Vessels; wherein, though will them too full be judged by manya Compendious practise, because the steams have a less way to ascend, the Experience has several times informed me, that, at least in some case, they take wrong measures, and that (to pass by another Cause of their disappointment) a large proportion

48 Df the Bechanical Dzigine tion of Air, purposely left in the Veffels, may more than compensate the greater space that is to be ascended by the vapours or exhalations of the matter that is to be distilled or sublimed. And if, in close Vessels, the presence of the Air may promotethe ascension of bodies, it may well be expected, that the elevation of divers of them may be furthered by being attempted in open Veffels, to which the Air has free access. And if we may give any credit to the probable Relations of some Chymists, the Air does much contribute to the volatilization of some bodies that are barely, though indeed for no thort time, exposed to it. But the account on which the Air by its bare present or peculiar operations conduces to the Volatilization of some bodies, is a thing very difficult to be determined, without having recourse to some Notions about Gravity and Levity, and of the Constitution of the corpuscles that compose the Air; which I take to be both very numerous and

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and Production of Cholatility. 49
no less various. And therefore I must not in these occasional Notes such out into such a Subject, though, for fear I should be blamed for too much slighting my old acquaintance the Air, I durst not quite omit the power it has to dispose some bodies to

Volatility.

A moderate attention may suffice make it be discerned, that in what hit been hitherto delivered, I have by the most part considered the small untions of matter, to be elevated Volatilization, as intire Corpuscles: and therefore it may be now pertinent, to intimate in a Line or two, that there may be also Cases, wherehakind of Volatilization, improperblocalled, may be effected, by malinguse of such additaments as break for otherwise divide the particles of the corpuscles to be elevated, and hadhering to, and so clogging, one of the particles to which it proves more congruous, inable the other, hich is now brought to be more ght or disingaged, to ascend. This may 50 Df the Dechanical Dzigine may be illustrated by what happens, when Sal Armoniac is well ground with Lapis Calaminaris or with some fix'd Alkali, and then committed to distillation: For the Sea-salt, that enters the Composition of the Sa Armoniac, being detained by the stone or the Alkali, there is a divorce made between the common Salt and the urinous and fuliginous Salts, that were incorporated with it, and being now difingaged from it, are eafily elevated. I elsewhere mention, that I have observed in Man's Urine a kind of native Sal Armoniac, much less Volatile than the fugitive that is fublim'd from Man's Blood, Hartfhorn, &c. and therefore supposing, that a separation of parts may be made by an Alkali, as well in this Salt as in the common factitious Sal Armoniac, I put to fresh Urine a convenient proportion (which was 1 plentifull one) of Salt of Pot-alle (that being then at hand) and dilliling the Liquor, it yielded, according to expectation, a Spirit more Vo latile

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and Production of Avlatility. 51 file than the Phlegm, and of a vepiercing tast; which way of obnining a Spirit without any violence fire, and without either previally abstracting the Phlegm, (as we fain to do in fresh Urine) or tebuffy waiting for the fermentation ftale Urine, I taught some Chymits, because of the usefulness of hirt of Urine; which being obtaindthis innocent way, would probaby be employed with much less suficion of corroliveness, than if in me operation I had made use of dick lime. Another Illustration of wat I was not long fince faying, may refetch'd from the Experiment of mking Spirit of Nitre by mixing Mepeter with Oil of Vitriol, and dilling them together: For the Moes so divide or break the corpucles of the Nitre, that the nowposed particles of that Salt, which amount to a great portion of the hole, will be made easily enough walcend even with a moderate fire Sand, and sometimes without any

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fire at all, in the form of Spirits, ex. thi ceeding unquiet, subtle, and apt to

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To which Instances of this imperfect kind of Volatilization more might be added, but that you may well think, I have detain'd you bu too long already with indigelled Notes about one Quality.

CHAP. VII.

He last means of Volatilizing bodies is, the operation of the Fire or some other actual Heat: But of this, which is obvious, it would be superfluous to discourse. Onely this I shall intimate, that there may be bodies, which, in such degrees of fire as are wont to be given in the vulgar operations of Chymists, will not be elevated, which yet may be forced up by such violent and lasting fires, as are employed by the Melten of Ores, and Founders of Guns, and fometimes by Glass-makers. And on this

and Production of Colatility. 53 his Consideration I shall here oberve to you, fince I did not doe it at my entrance on these Notes, that Chymists are wont to speak, and I ave accordingly been led to treat, of Volatility and Fixity in a popular fose of those Terms. For if we would confider the matter more fridly, I presume we should find that Volatility and Fixity are but rehive Qualities, which are to be estimated, especially the former of them, by the degree of fire to which the body, whereto we ascribe one or oher of those Qualities, is exposed; and therefore it is much more difficult then men are aware of, to determine activately, when a body ought to beaccounted Volatile and when nots face there is no determinate degree of Heat agreed on, nor indeed easie be devised, that may be as a stanand, whereby to measure Volatility and Fixtness: And 'tis obvious, that body, that remains fixt in one denee of fire, may be forced up by ather, To which may be added, agree-

54 Of the Wechanical Digine agreeably to what I lately began to observe, that a body may pass for absolutely fixt among the generality of Chymists, and yet be unable to persevere in the fires of Founders and Glass-makers: Which brings into me mind, that not having observed, that Chymists have examined the Fixing of other bodies than metalline one by the Cupel, I had the Curiofity to put dry Salt of Tartar upon it, and found, as I expected, that in no long time it manifestly wasted in so well ment a heat, wherein also the Ar came freely at it, (though Quick-line, handled after the same way, lost not of its weight,) and having well mix ed one ounce of good Salt of Tartar with treble its weight of Tobac co-pipe Clay, we kept them but for two, or at most three hours, in strong fire; yet the Crucible being purposely left uncovered, we found the Salt of Tartar fo wasted, that the remaining mixture (which was not flux'd) afforded us not mear a quantel of an ounce of Salt. And indeed **fcarce**

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and Production of Tolatility. 55 farce doubt, but that in strictness dien of those bodies that pass for abblutely fixt, are but semi fixt, or at all but comparatively and relativefix'd, that is, in reference to such egrees of fire, as they are wont to exposed to in the Distillations, limations, &c. of Chymists; not as are given in the raging fires of founders, and Glass-makers. And perhos even the fires of Glass-makers and Say-masters themselves are not he most intense that may possibly he made in a short time, provided there be but small portions of matter be wrought on by them. And in eled, I know very few bodies, be-Mes Gold, that will persevere totally min the vehementest degrees of fire the Trials have made me acquainted with And I elsewhere tell you, that, bough Tin, in our Chymical Reverbuatories themselves, is wont to be reduced but into a Calx that is repued very fixt; yet in those intense tes, that a Virtuoso of my acquainnce uses in his Tin-Mines, there is 100

56 Df the Wechanical Dzigine

not seldom found quantities of The carried up to a notable height in the form of a whitish powder, which being in good masses forced off from the places to which it had fastened it self, does by a skillful reduction yield many a pound weight of good malleable metal, which seemed to meno be rather more, than less, fine than ordinary Tin.

Postscript,

Relating to Page 15. of this Tract; and here annext for their Sakes, who have a mind to repeat the Experiment then delivered, that so they may know the quantities employed in it.

ground very well three parts of Sal Armoniac, and having sublimed them in a strong fire, we took off the high coloured Sublimat, and put in either an equal weight, or a weight exceeding it by half, to the Capu Mortuum, we found after the second Sublimation, which was also high coloured, that of an ounce of Crocus we had raised in drams, that is, three quarters of the whole weight.

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EXPERIMENTAL

NOTES

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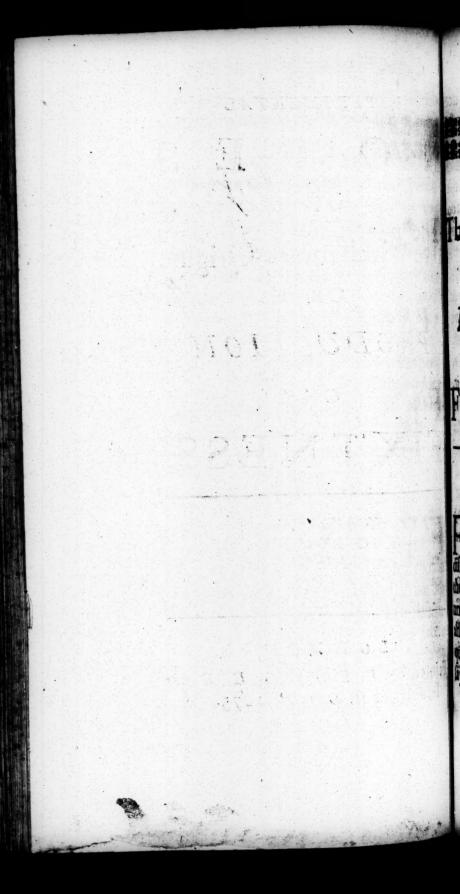
OF

FIXTNESS.

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LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.





OF

The Mechanical Origine

OR

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CHAP. I.

lity to Volatility, what we have accounted about the latter, will make account and upon that account how me to make somewhat the account for dispatch of what I have to for of it.

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The Qualifications that conduct most to the Fixity of a portion of mat-

ter, seem to be these.

First, the grossness or the bulk d the corpuscles it consists of. Foris these be too big, they will be too unwieldy and unapt to be carried up into the Air by the action of such mi nute particles as those of the Fire, and will also be unfit to be buoyed up by the weight of the Air; as we fee, that Vapours, whilst they are such, are small enough to swim in the Air, but can no longer be sustained by it, when they convene into drops of rain or flakes of snow. But here it is to be observed, that when I speak of the corpuscles that a fixt body confifts of, I mean not either its Elementary or its Hypostatical Principles, as such, but onely those very little masses or clusters of particles, of what kind for ever they be, that stick so firmly to one another, as not to be divisible and diffipable by that degree of fire in which the body is said to be fixt; so that each of those little Concretions,

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or Production of Fixtness.

ous, though it may it felf be made up of two, three, or more particles of a impler nature, is confidered here per udum Unius, or as one intire corpucle. And this is one Qualification muducive to the Fixtness of a bo-

The next is the ponderousness or blidity of the corpufcles it is made up for if these be very solid, and (which folid and compact bodies whally are) of a confiderable specifix gravity, they will be too heavy bbe carried up by the effluvia or he action of the fire, and their ponderousness will make them as unwiely, and indisposed to be elevated by he Agents, as the groffness of their bulk would make bigger corpuscles, but of a proportionably inferiour heisick weight. On which account the calces of some metals and minerals, as Gold, Silver, &c. though, by the operation of Solvents, or of the he, or of both, reduced to powders acceedingly subtile, will resist such rehement fires, as will eafily drive

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Df the Bechanical Dzigine up bigger, but less heavy and con in

pact, corpuscles, than those cakes

confift of

The third Qualification that conduces to the Fixity of a body, he is
longs to its Integral parts, not barely to as they are several parts of it, but a they are aggregated or contexed in to one body. For, the Qualification, I mean, is the ineptitude of the com ponent corpuscles for avolation, by reason of their branchedness, inc. gular figures, crookedness, or other le inconvenient shape, which intangle it the particles among one another, and makes them difficult to be extricated; by which means, if one of them do a ascend, others, wherewith its complicated, must ascend with it; and whatever be the account on which it divers particles stick firmly together, the aggregate will be too heavy of the therefore take notice of, because that, though usually 'tis on the rough. ness and irregularity of corpuscles, that their cohesion depends; yet i lome.

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or Production of Fixtnels.

merimes happens, that the smoothes and flatness of their surfaces makes them fo stick together, as to fift a total divulsion; as may be instrated by what I have faid of the mhesion of polished marbles and the lates of glass, and by the fixity of

his it self in the fire.

From this account of the Causes or lequifites of Fixity, may be deduthe following means of giving or ding Fixation to a body, that was these means may be reduced to two meral Heads; First, the action of he Fire, as the parts of the body, spoled to it, are thereby made to perate variously on one another. Inducat, the affociation of the parides of a volatile body with those Some proper additament: Which mm, [of proper] I rather imploy than hat, one would expect, [of fixt;] because 'twill ere long appear, that, ocertain cases, some volatile bodies my more conduce to the fixation of ther volatile bodies, than some fixt A 4 ones

ones doe. But these two Instruments of Fixation being but general, I shall propose four or five more particular ones.

CHAP. II.

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ND first, in some cases it may conduce to Fixation, that, either by an additament, or by the operation of the fire, the parts of a body be brought to touch each other in large portions of their furfaces. For, that from such a contact there will follow fuch a mutual cohesion, as will at least indispose the touching corpuscles to suffer a total divulsion, may appear probable from what we lately noted of the cohesion of pieces of marble and glass, and from some or ther Phenomena belonging to the History of Firmness, from which we may properly enough borrow fome instances, at least for illustration, in the Doctrine of Fixtness, in regard usually, though not always, that the or Production of Firtnets.

e same things that make a body in, give it some degree of Fixity, keeping it from being dissipated the wonted degrees of Heat, and gitation it meets with in the Air. ht to return to the contact we were heaking of, I think it not impossible, hough you may perhaps think it frange,) that the bare operation of he Fire may, in some cases, procure scobesson among the particles, (and micquently make them more Fixt,) swell as in others disjoyn them, and hereby make them more Volatile. for, as in some bodies, the figures and ites of the corpuscles may be such, but the action of the fire may rub utear off the little beards or hooks, nother particles that intangle them, ndby that means make it more easie in the corpuscles to be disingaged ad fly upwards; so in other bodies, he fize and shape of the corpuscles my be such, that the agitation, cauld by the fire, may rub them one gainst the other, so as by mutual attion to grind, as 'twere, their fur-

10 Of the Wechanical Dzigine furfaces, and make them fo brown and smooth, if not also so flat, as the the contact of the corpuscles the come to be made according to a large portion of their superficies, from whence will naturally follow a firm Cohesion. Which I shall illustrate by what we may observe among those that grind glaffes for Telescopes and Microscopes. For, these Artificen, by long rubbing a piece of glass a. gainst a metalline Dish or concave Vessel, do by this attrition at length bring the two bodies to touch one another in so many parts of their congruous surfaces, that they will stick firmly to one another, so as fometimes to oblige the Work-man to use violence to disjoyn them, And this instance (which is not the sole I could alleage) may suffice to shew, how a Cohesion of corpuscles may be produced by the mutual adaptation of their congruous surfaces. And if two groffer corpuscles, or a greater number of smaller, be thu brought to stick together, you will easily

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afily believe, their Aggregate will move too heavy or unwieldy for aplation. And to shew, that the fire sof some corpuscles, I have someimes caused Minium, and some oher calces, that I judged convenient, whe melted for a competent time, is vehement fire conveniently administred; whereby, according to apedation, that which was before dull and incoherent powder, was muced into much groffer corpufcles, militudes of whose grains appeam smooth, glittering, and almost becular, like those of fine litharge igold; and the masses that these mins composed, were usually solid bough and of difficult fusion. And when we make glass of Lead per se, which I elsewhere teach you how udoe,) 'tis plain, that the particles of the Lead are reduced to a great moothnes; fince, wherefoever you mak the glass, the surfaces, produthat the crack, will not be jagged, in smooth, and considerably specular.

12 Of the Wechanical Dzigine lar. Nor do I think it impossible that, even when the fire does not make any great attrition of the Con Qu puscles of the body to be fixt, it may be yet occasion their sticking together, in because by long tumbling them up and down in various manners, it my at length, after multitudes of revo. lutions and differing occursions, bring on those of their surfaces together, in which, by reason of their breadth, in smoothness, or congruity of figure, in are fit for mutual cohesion; and of when once they come to stick, there to is no necessity, that the same causes, that were able to make them pass by one another, when their contact was but according to an inconsiderable part of their surfaces, should have the same effect now, when their contact is full; though perhaps, if the degree of fire were much increased, the a more vehement agitation would furmount this cohesion, and distipate again these clusters of coalescent corpuscles.

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These conjectures will perhapsap pear

or Production of Fixtnels. hear less extravagant, if you consider that happens in the preparation of Quick-silver præcipitated per se. For bere, running Mercury, being put no a conveniently shaped Glass, is aposed to a moderate fire for a con-derable time: (For I have somemes found fix or seven weeks to be no short a one.) In this degree of me the parts are variously tumbled, made many of them to ascenda donvening into drops on the fides othe glass, their weight carries them hown again; but at length, after many mutual occursions, if not also minions, some of the parts begin to together in the form of a red moder, and then more and more Mercurial particles are fastened to it, at length all, or by much the mater part of the Mercury, is reaced into the like Pracipitate, which, whis cohesion of the parts, being fown more fixt, will not with the me degree of Heat be made to rise d circulate, as the Mercury would wore; and yet, as I eliewhere note,

I have

14 Di the Bechanical Dzigine I have found by trial, that, with greater and competent degree of heat, this Pracipitate per fe, would without the help of any volatilizing additament, be easily reduced into running Mercury again. Chymill and Physicians, who agree in suppor fing this Pracipitate to be made with out any additament, will perchant scarce be able to give a more likely account of the confistency and de gree of Fixity that is obtained in the Mercury; in which, fince nobo dy is added to it, there appears not to be wrought any but a Mechanical to change. And though, I confess, I have not been without suspicions, that in Philosophical strictness this Pracipitate may not be made per fis but that some penetrating igneous particles, especially saline, may have affociated themselves with the Mercurial Corpuscles; yet even upon this supposition it may be said, that he these particles contribute to theele fect that is produced, but by facilities ting or procuring, by their opport tune

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or Production of firtness. 15 me Interposition, the mutual Coheion of Corpuscles that would not alterwise stick to one another.

Perhaps it will not be altogether pertinent to add, on this occasion. it as for the generality of Chymists. well others as Helmontians, that afthe Transmutation of all metalls Gold by the Philosopher's Stone. ethinks, they may grant it to be proble, that a new and fit Contexture othe parts of a volatile body may. opecially by procuring a full contact mong them, very much contribute make it highly fixt. For, to omit mat is related by less credible Auhours, 'tis averred, upon his own in, by Helmont, who pretended not whe Elixir, that a grain of the powin, that was given him, transmuted found (if I mis-remember not) of maing Mercury; where the proportion of the Elixir to the Mercury to inconsiderable, that it cannot mionably be supposed, that every Impusele of the Quick-silver, that More was volatile, was made extreamly

16 Df the Wechanical Dzigine treamly fixt meerly by its Coalitioning with a particle of the powder, fince to to make one grain suffice for the Coalition, the parts it must be division ded into must be scarce conceivable, minute, and therefore each single to part not likely to be fixt it self, or a the least more likely to be carried up by the vehemently agitated Mercur, than to restrain that from avolation; whereas, if we suppose the Elixirio have made such a commotion among to the corpuscles of the Mercury, as an (having made them perhaps somewhat change their figure, and expelled some inconvenient particles,) to bringthem in to flick to one another, according to a very great portions of their surfaces, and intangle one another, it will not be disagreeable to the Mechanical Doctrine of Fixity, that the Mercury should endure the fire as well as the Gold, on the score of its new Text ture, which, supposing the story of ced, by the new colour, specific and gravity, Indissolubleness in Aqua fortis,

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or Production of Fixtness. nis, and other Qualities wherein fold differs from Mercury, espely Malleableness, which, accoring to our Notes about that Qualiusually requires that the parts, on whose union it results, be eiher hooked, branched, or other-ileadapted and fitted to make them he fast hold of one another, or declose to one another. And fince, the whole mass of the factitious Gold, all save one grain must be mawilly the same body, which, before heprojection was made, was Quickher, we may see how great a pro-union of volatile matter may, by ainconfiderable quantity of fixing Mitament, acquire such a new Disminion of its parts, as to become of fixt. And however, this Inluce will agree much better with Mechanical Doctrine about Fixi-, than with that vulgar Opinion the Chymists, (wherewith twill tat all comply,) That if in a mix-

te, the volatile part do much ex-

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or at least a good portion thereof, with it; and on the contrary. But though this Rule holds in many cases, where there is no peculiar indisposition to the effect that is aimed at; yet if the Mechanical affections of the bodies be ill suited to such a purpose, our Philosophical Experiment manifestly proves, that the Rule will not hold, since so great a multitude of grains of Mercury, in stead of carrying up with them one grain of the Elixir, are detained by it in the strongest fire. And thus much for the sustained by of fixing Volatile Bodies.

CHAP. III.

Fixity, is by expelling, breaking, or otherwise disabling those volatile Corpuscles that are too indisposed to be fixt themselves, or are stitled to carry up with them such particles as would not, without their help, ascend. That the Expussion is

of such parts is a proper means to make the aggregate of those that remin more fixt, I presume you will to put me solicitously to prove; and we have a manifest instance of it i soot, where, though many active arts were by the violence of the reand current of the air carried up mether by the more volatile parts 3 nt, when Soot is well distilled in a letort, a competent time being giinfor the extricating and avolation the other parts, there will at the bottom remain a substance that will nt now fly away, as it formerly did. had here let me observe, that the messe of the fugitive corpuscles may intribute to the fixation of a body, m barely because the remaining latter is freed from so many unfixt, footalfo volatilizing, parts; but, as may often happen, that upon their messe the pores or intervals, they If behind them, are filled up with fore folid or heavy matter, and the dy becomes, as more homogeneous, more close and compact. And where-B 2

20 Of the Wechanical Dzigine whereas I intimated, that, besides the expulsion of unfit corpuscles they may be otherwise disabled from hindering the fixation of the mask they belong to, I did it, because it feems very possible, that in some a. fes they may, by the action of the fire, be so broken, as with their frag. ments to fill up the pores or intervals of the body they appertained to; or may make fuch coalitions with the particles of a convenient additament. as to be no impediment to the Fixity of the whole masse, though they remain in it. Which possibly you will think may well happen, when you shall have perused the Instances annext to the fourth way of fixing bodies.

The third means of fixing, or lessening the Volatility of, bodies, is by preserving that rest among the parts, whose contrary is necessary to their Volatilization. And this may be done by preventing or checking that Heat, or other motion, which external Agents strive to introduce into

des into the parts of the proposed body.

cs, but this means tending rather to hindre the actual avolation of a portion of matter, or, at most, procure a temit prary abatement of its volatility, as han to give it a stable fixity, I shall

te pot any longer infift on it.

The fourth way of producing fixity in a body, is by putting to it fich an appropriated Additaments whether fixt or volatile, that the Corpuscles of the body may be put mong themselves, or with those of the additament, into a complicated late, or intangled contexture. This being the usual and principal way of moducing Fixity, we shall dwell bewhat the longer upon it, and ave Instances of several degrees of fixation. For, though they do not produce that quality in the strictest eceptation of the word, Fixity; pet'tis usefull in our present inquiry, btake notice, by what means that rolatility comes to be gradually abanderstanding, how the Volatility of B 2

of a body comes to be totally abated, and consequently the body to be fixt.

CHAP. IV.

A ND first we find, that a fixtad. ditament, if its parts be conve niently shaped, may easily give a degree of fixity to a very volatile body. Thus Spirit of Nitre, that will of it self easily enough fly away in the Air, having its saline particles als fociated with those of fixt Nitre, or Calt of Tartar, will with the Alkaly compose a salt of a Nitrous nature, which will endure to be melted in a Crucible without being deprived even of its Spirits. And I have found that the spirits of Nitre, that abound in Aqua fortis, being concoagulated with the Silver they corrode, though one would not expect that fuch fub tile Corpuscles should stick fast tole compact and folid a body as Silveri yet Crystalls, produced by their Coali-

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Coalition, being put into a Retort, to may be kept a pretty while in fusion, before the metal will let go the Ninous spirits. When we poured oil of Vitriol upon the Calx of Vitriol, though many Phlegmatick and other Sulphureous particles were driven away by the excited Heat; vet the faline parts, that combined with the fixt ones of the Colcothar, stuck fift enough to them, not to be eafily diven away. And if Oil of Vitriol he in a due proportion dropt upon salt of Tartar, there refults a Tartanm vitriolatum, wherein the acid andalkalizate parts cohere fo strongh, that 'tis not an ordinary degree offire will be able to disjoyn them. blomuch that divers Chymists have (though very erroniously) thought this compounded Salt to be indestrudible. But a less heavy liquour than the ponderous Oil of Vitriol may by an Alkaly be more strongly detained than that Oil it self; experience haring affured me, that Spirit of Salt being dropt to satiety upon a fixt
B 4 Alkaly,

24 Of the Wechanical Dzigine

alkaly, (I used either that of Nitte or of Tartar,) there would be made the so strict an union, that, having, with out additaments, distilled the resulting salt with a strong and lasting sire, it appeared not at all considerably to be wrought upon, and was not so much to

as melted.

But 'tis not the bare Mixture or in Commission of Volatile particle ! with Fixt ones, (yea though the for In mer be predominant in quantity,) that will suffice to elevate the latter, in For, unlesse the figures of the latter be congruous and fitted to fallen to the other, the volatile parts will fly away in the Heat, and leavethe rest as fixt as before : as when fand or ashes are wetted or drenched with water, they quickly part with that water, without parting with any degree of their Fixity. But on theother fide, it is not always necessary, that the body, which is fitted to destroy, or much abate, the volatility of another substance, should be Relf fixt. For, if there be a skilled 10

or Production of Firtnels. 25 a lucky coaptation of the figures of he particles of both the bodies, hele particles may take such hold of me another, as to compose corpucles, that will neither by reason of heir strict union be divided by Heat; nor by reason of their resulting grossness be elevated even by a strong in, or at least by such a degree of Heat as would have sufficed to raile more indisposed bodies than either of he separate Ingredients of the mixure. This observation, if duly made out does so much favour our Dodine about the Mechanical Origine fixation, and may be of such use, monely to Chymists, in some of their operations, but to Philosophers, in afgoing the causes of divers Phanomew of Nature, that it may be worth while to exemplifie it by some Inlances.

The first whereof I shall take from a usual practice of the Chymists themselves: which I the rather doe, to bet you see, that such known Experiments are too often over-looked

26 Pf the Wechanical Dzigine

by them that make them, but year may hint or confirm Theories to those that reflect on them. Thele stance, I here speak of, is that which is afforded by the vulgar Prepara tion of Bezoardicum Minerale. For though the rectified Butter or Oil of Antimony and the Spirit of Nitre, the are put together to make this white Pracipitate, are both of them distilled liquours; yet the copious powder, that results from their Union, is, by that Union of volatile parts, fofir fixt, that, after they have edukonted it with water, they prescribethe or fix hours: which operation it to could not bear, unless it had attained to a considerable fixation. This difcourse supposes with the generality of Chymists, that the addition of a due quantity of spirit of Nitre, is necessary to be employed in making the Bezoardicum Minerale. But if i be a true Observation, which is atti buted to the Learned Guntherus Bit lichius, (but which I had no Furnace

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or Production of Fixtness. hand to examine when I heard of i) if, I fay, it be true, that a Bezoadicum Minerale may be obtained, ithout spirit of Nitre, barely by a low evaporation, made in a Glaffein, of the more fugitive parts of to Oil of Antimony; this Instance not indeed be proper in this ace, but yet will belong to the feand of the foregoing ways of introusing Fixity. I proceed now to allege other particulars in favour of be above-mentioned Observation. If you take strong spirit of salt, but, when the Glass is unstopt, will mak of it felf in the cold air, and hate it with the volatile spirit of Vine, the superfluous moissure beig abstracted, you will obtain by preparation (which, you may member, I long fince communicato you, and divers other Virtuoli,) compounded Salt, scarce, if at all, linguishable from Sal Armoniac, which will not, as the Salts it while of will doe, before their cowion, easily fly up of it self into the

air,

28 Df the Mechanical Dzigine air, but will require a not despicable

degree of fire to sublime it.

Of these semivolatile Compositions of Salt I have made, and else where mentioned, others, which I shall not here repeat, but passeons other Instances pertinent to our present defeat.

sent design.

I lately mentioned, that the Volatility of the spirits of Nitre may be very much abated, by bringing them to coagulate into Crystalls with particles of corroded Silver; but I shall now add, that I guessed, and by trial found, that these Nitrous spirits may be made much more fixt by the addition of the Spirit of Salt, which, if it be good, will of it felf fmoak in the Air. For, having diffolved a convenient quantity of Crystalls of Silver in distilled water, and precipitated them, not with a Solution of Salt, but the spirit of Salt; the phlegm being abstracted, and some few of the loofer saline particle; though the remaining masse were prest with a violent fire that kept

or Production of Firtness. 29

able Retort red-hot for a good while;

the Nitrous and Saline spirits

for rould by no means be driven away

from the Silver, but continued in su
line with it; and when the masse was

to uken out, these Spirits did so abound in it, that it had no appearance of a Metal, but looked rather like a thick

piece of Horn.

The next Instance I shall name is forded us by that kind of Turbith, which may be made by Oil of Vitriol, instead of the Aqua fortis imployed in the common Turpethum Minerale. For, though Oil of Vitriol be a distilled buour, and Mercury a body volatile though; yet, when we abstracted four or five parts of Oil of Vitriol fom one of Quick-filver, (especialif the operation were repeated,) and then washed off as much as we ould of the saline particles of the Oil of Vitriol; yet those that remained athering to the Mercury made it far note fixt, than either of the liquours d been before, and inabled it even La Crucible to endure such a degree of

30 Of the Wechanical Dzigine of fire, before it could be driven a way, as, I confess, I somewhat won The like Turbith may be dered at. made with Oil of Sulphur per Campe. But this is nothing to what Helmont tells us of the operation of his Alkaheft, where he affirms, that that Menstruum, which is volatile e nough, being abstracted from running Mercury, not onely coagulates it, but leaves it fixt, so that it will endure the brunt of fires acuated by Bellows, (omnem follium ignem.) If this be certain, it will not be a flender proof, that Fixity may be Mechanically produced; and however, the Argument will be good in reference to the Helmontian Spagyrists. For if, as one would expect, there do remain some particles of the Menstrum with those of the metal, it will not bede nied, that two volatile substances may perfectly fix one another, And if, as Helmont feems to think, the Menstruum be totally abstracted, this supposition will the more favour our Doctrine about Fixity; since, there

or Production of Fixtnels. there be no material additament lest with the Quick-filver, the Fixation annot so reasonably be ascribed to by thing, as to some new Mechanical modification, and particularly to ome change of Texture introduced

nto the Mercury it felf.

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And that you may think this the s kimprobable, I will now proceed n some Instances, whereof the first full be this; That, having put a mixme made of a certain proportion of two dry, as well as volatile, bodies, wis. Sal Armoniac, and Flower or very fine powder of Sulphur,) to half is weight of common running Merary, and elevated this mixture three usour times from it, (in a convenionly (haped, and not over-wide, glass) the Mercury, that lay in the bottom intheform of a ponderous and fomewhat purplish powder, was, by this operation fo fixt, that it long endured altrong fire, which at length was made so strong, that it melted the flass, and kept it melted, without king strong enough to force up the Mer-

32 Df the Wechanical Dzigine Mercury: which, by some trials, not so proper to be here mentioned feemed to have its salivating ande metick powers extraordinarily infinged, and fometimes quite suppressed, But this onely upon the bye. the other Instances, (wherewith) shall conclude these Notes,) I sall employ one Menstruum, Oil of Vitriol, and shew you the efficacy of it in fixing some parts of volatile bodies with some parts of it self; by which examples it may appear, that a Volatile body may not onely leffen the volatility of another body, as in the lately mentioned case of our spirituous Sal Armoniac; but that two Substances, that apart were volatile, may compose a third, that will not onely be less volatile, but considera bly (if not altogether) fixt,

We mixed then, by degrees, a bout equal parts of Oil of Vitriol and Oil of Turpentine: and though each of them single, especially the latter, will ascend with a moderate fire in a Sand-surnace; yet, after the Distri-

lation

or Production of Firtnels. 33

lation was ended, we had a confiderable quantity, sometimes (if I misremember not) a fifth or fixth part,
of a Caput Mortuum black as a Coal,
and whereof a great part was of a
fearce to be expected fixtness in the
fire.

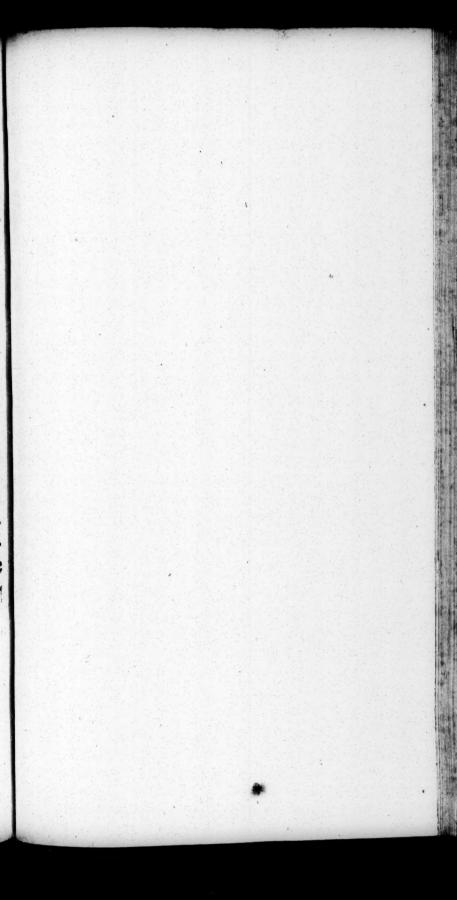
To give a higher proof of the disposition, that Oil of Vitriol has to let some of its parts grow fixt by combination with those of an exceeding volatile additament, I mixed this liquour with an equal or double weight of highly rectified spirit of wine, and not onely after, but sometimes without, previous digestion, I sound, that the fluid parts of the mixture being totally abstracted, there would remain a pretty quantity of a black Substance so fixt as to afford just cause of wonder.

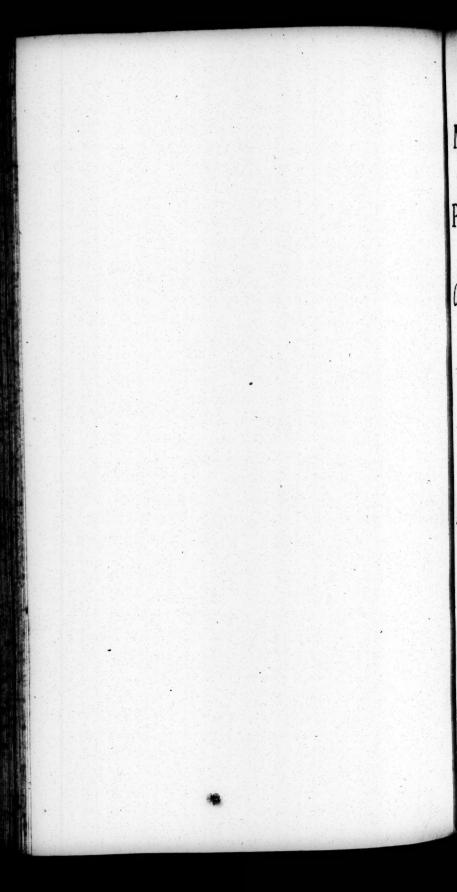
And because Campbire is esteemed the most sugitive of consistent bodies, in regard that, being but laid in the free air, without any help of the fire, it will fly all away; I tried, what Oil of Vitriol abstracted from

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Camphire would doe; and found at the bottom of the Retort a greater quantity than one would expect of a Substance as black as pitch, and almost as far from the volatility as from the colour of Camphire, though it appeared not, that any of the Gum had sublim'd into the neck of the Retort.

From all which Instances it seems manifestly enough to follow, that in many cases there needs nothing to make associated particles, whether volatile or not, become fixt, but either to implicate or intangle them among themselves, or bring them to touch one another according to large portions of their surfaces, or by both these ways conjoyntly, or by some others, to procure the firm Cohrison of so many particles, that there sulting Corpuscles be too big or heavy to be, by the degree of sixt, driven up into the Air.





Experiments and Potes

ABOUTTHE

MECHANICAL ORIGINE

OR

PRODUCTION

OF

CORROSIVENESS

AND

CORROSIBILITY.

By the Honourable ROBERT BOYLE Esq; Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.

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Experiments and Notes ABOUT THE

MECHANICAL PRODUCTION

OF

CORROSIVENESS

AND

CORROSIBILITY.

SECT. I.

About the Mechanical Origine of Corrosiveness.

To not in the following Notes treat of Corrosiveness in their strict sense of the word, who assibe this Quality only to Liquors, that are notably acid or sowre, such as agua fortis, Spirit of Salt, Vinegar, A 2 Juice

Df the Wechanical Dzigine of Juice of Lemons, &c. but, that I may not be oblig'd to overlook Urinous, Oleous, and divers other Solvents, or to coin new names for their differing Solutive Powers, I prefume to employ the word Corrofiveness in a greater latitude, fo as to make it almost equivalent to the 80lutive power of Liquors, referring other Menstruums to those that are Corrolive or fretting, (though not always as to the most proper, yet) as to the principal and best known species; which I the less scruple here to do, because I have * elsewhere more distinctly enumerated and forted the Solvents of bodies.

* This refers to an Essay of the Authors about the Usefulness of Chymistry to, &c.

The Attributes that seem the most proper to qualifie a Liquor to be Corrosive, are all of them Mechanical, being such as are these that sollow:

of, or abound with, Corpuscles not

Correlibentle of Correlibility. 3
100 big to get in at the Pores or
Committures of the body to be diffolved; nor yet be so very minute
as to pass through them, as the beams
of Light do through Glass; or to
be unable by reason of their great
flenderness and flexibility to disjoyn
the parts they invade.

secondly, That these Corpuscles be of a shape sitting them to infinuate themselves more or less into the Pores or Commissures above-mentioned, in order to the dissociating of

the folid parts.

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petent degree of solidity to disjoyn the Particles of the body to be dissolved; which Solidity of Solvent corpuscles is somewhat distinct from their bulk, mention'd in the first Qualification; as may appear by comparing a stalk of Wheat and a metalline Wire of the same Diameter, or a flexible wand of Osier of the bigness of ones little singer, with a rigid rod of Iron of the same length and thickness.

A 3 Fourth-

4 Df the Wechanical Dzigine of

Fourthly, That the Corpuscles of the Menstruum be agile and advantaged for motion, (fuch as is fit to disjoyn the parts of the invaded bo. dy) either by their shape, or their minuteness, or their fitness to have their action befriended by adjuvant Causes; such as may be (first) the pressure of the Atmosphere, which may impell them into the Pores of bodies not fill'd with a Substance fo refifting as common Air: As welee, that water will by the prevalent pressure of the Ambient, whether Air or Water, be raised to the height of some inches in capillary Glasses, and in the pores of Spunges, whole consistent parts being of easiercess. on than the sides of Glass-pipes, those Pores will be enlarged, and consequently those sides disjoyn'd, as appears by the dilatation and fwelling of the Spunge: And (fe condly) the agitation, that the intruding Corpufcles may be fitted to receive in those Pores or Commilfures by the transcursion of some **fubtile**

Corrolibenels of Corrolibility. 5 subtile ethereal matter; or by the numerous knocks and other pulses of the swimming or tumbled Corpuscles of the Menstruum it self, (which being a fluid body, must have its fmall parts perpetually and varioully moved) whereby the engaged Corpuscles, like so many little Wedges and Leavers, may be enabled to wrench open, or force asunder the litle parts between which they have infiguated themselves. But I shall not here prosecute this Theory. (which, to be handled fully, would require a discourse apart) since these Conjectures are propos'd but tomake it probable in the general, That the Corrosiveness of bodies may be deduced from Mechanical Principles: But whether best from the newly propos'd ones, or any other, need not be anxiously consider'd in these Notes, where the things mainly intended and rely'd on, are the Experiments and Phanomena themfelves.

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EXPER. I.

'Is obvious, that, though the recently exprest Juice of Grapes be sweet, whilst it retains the Texture that belongs to it as 'tis new, (especially if it be made of some forts of Grapes that grow in hot Regions,) yet after fermentation, 'twill, in tract of time, as 'twere spontaneously, degenerate into Vine In which Liquor, to a multigar. tude of the more solid Corpulcles of the Must, their frequent and mutual Attritions may be supposed to have given edges like thole of the blades of swords or knives; and in which, perhaps, the confused agiation that preceded, extricated, or, as it were, unsheathed some acid particles, that (deriv'd from the sapof the Vine, or, perchance more originally, from the juice of the Earth) were at fift in the Must, but lay conceal'd, and as it were sheathed, among

Coprolibenels of Corrolibility. 7 among the other particles wherewith they were affociated, when they were prest out of the Grapes. Now this Liquor, that by the forementioned (or other like) Mecha-nical Changes is become Vinegar, does so abound with Corpuscles, which, on the account of their edges, or their otherwise sharp and penetrative shape, are Acid and Corrofive, that the better fort of it will, without any preparation, dissolve Coral, Crabs-eyes, and even some Stones, Lapis stellaris in particular, as also Minium, (or the Calx of Lead) and even crude Copper, as we have often tried. And not onely the distill'd Spirit of it will do those things more powerfully, and perform some other things that meer Vinegar cannot; but the saline particles, wont to remain after Distillation, may, by being distill'd and cohobated per se, or by being skilfully united with the foregoing Sp'rit, be brought to a Menstruum of no small efficacy in the dissolution.

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8 Of the Bechanical Deigine of and other preparations of metalline bodies, too compact for the men Spirit it self to work upon.

From divers other sweet things also may Vinegar be made; and even of Honey, skilfully fermented with a small proportion of common water, may be made a Vinegar stronger than many of the common Winevinegars; as has been affirmed to me by a very candid Physician, who had occasion to deal much in Liquors.

EXPER. II.

and other Bodies that most of them pass for insipid, but Honey and Sugar themselves afford by Disstillation Acid Spirits that will dissolve Coral, Pearls, &c. and will also corrode some Metals and metaline Bodies themselves; as I have often sound by Trial. So that the violent Operation of the sire, that descripts

Corrolibenels or Corrolibility. 9 froys what they call the Form of the distill'd body, and works as a Mechanical Agent by agitating, breaking, dissipating, and under a new constitution reassembling the parts, procures for the Distiller an Acid Corrofive Menstruum; which whether it be brought to pass by making the Corpuscles rub one another into the figure of little sharp blades, or by splitting some solid parts into sharp or cutting Corpufeles, or by unsheathing, as it were, some parts, that, during the former Texture of the body, did not appear to be acid; or whether it be rather effected by some other Mechanical way, may in due time be further confidered.

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EXPER. III.

Is observ'd by Refiners, Gold. smiths and Chymists, that Aqua Fortis and Aqua Regia, which are Corrolive Menstruums, dissolve Metals, the former of them Silver, and the latter Gold, much more speedily and copiously when an external heat gives their intestine motions a new degree of Vehemency or Velocity, which is but a mechanical thing; and yet this superadded measure of Agitation is not onely in the abovemention'd Instances a powerfully affistant Cause in the So. lutions made by the lately mention'd Corrosive Liquors, but is that without which some Menstruums are not wont sensibly to corrode some bodies at all, as we have tried in keeping Quick-filver in three or four times its weight of Oyl of Vitrioli fince in this Menstruum I found not the Mercury to be dissolved or corroded.

Corrolibenels of Corrolibility. 11 noded, though I kept it a long time in the Cold: Whereas, when the Ovl of Vitriol was excited by a convenient heat, (which was not faint) it corroded the Mercury into ifine white Calx or powder, which, by the affusion of fair water, would he presently turn'd into a yellowish calz of the colour and nature of a Turbith. I remember also, that having for trials sake dissolv'd in a weak Spirit of Salt, a fourth part of is weight of fine Crystals of Nitre, we found, that it would not in the cold (at least during a good while that we waited for its operation) disblve Leaf-gold; but when the Menfrum was a little heated at the fire, the Solution proceeded readily enough. And in some cases, though the external heat be but small, yet there may intervene a brisk heat, and much cooperate in the dissolution of Body; as, for instance, of Quicksilver in Aqua Fortis. For it is no prodigy to find, that when a full proportion of that fluid Metal has been

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been taken, the Solution, though a first altogether liquid, and as to sense uniform, comes to have after while a good quantity of coagulated or crystallized matter at the bottom, of which the cause may be that in the very act of Corroson there is excited an intense degree of heat, which conferring a new degree of agitation to the Menstruum, makes it dissolve a good deal more, than afterwards, when the Consideration over, it is able to keep up.

EXPER. IV.

Agitation does in some cafes so much promote the Dissolutive power of Saline bodies, that though they be not reduc'd to that subtility of parts, to which a strong Dissilation brings them; yet they may in their grosser and cruder form have the power to work on Metals; as I elsewhere shew, that by barely boilCorrosibenels of Corrosibility. 13 a ing some Solutions of Salts of a de convenient structure, as Nitre, Sal Armoniac, &c. with foliated Gold, & Silver, &c. we have corroded these Metals, and can dissolve some others. And by boiling crude Copper (in Filings) with Sublimate and common water, we were able, inno long time, to make a Solution of the Metal.

EXPER. V.

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Cometimes also, so languid an Agitation, as that which feems but afficient to keep a Liquor in the fate of fluidity, may suffice to give ome dry bodies a corroding power, which they could not otherwise extrile; as in the way of writing ones name (or a Motto) upon the blade of a knife with common Sublimate: for, if having very thinly overlaid which side you please with Beeswax, you write with a bodkin or some pointed thing upon it; the

14 Df the Wechanical Dzigine of Wax being thereby removed from the strokes made by the sharp body, 'tis easie to etch with Sublimates fince you need but strew the powder of it upon the place bared of the Wax, and wet it well with meer common water; for ftrong Vinegar is not necessary. For after a while all the parts of the blade that should not be fretted, being protected by the Case or Film of Wax, the Sublimate will corrode onely where way has been made for it by the bodkin, and the Letters will be more or less deeply in graven (or rather etch'd) according to the time the Sublimate is suffer'd to lye on. And if you aim onely at a legible impression, a few minutes of an hour (as four or five) may ferve the turn.

EXPER. VI.

His brings into my mind an Observation I have sometimes had occasion to make, that I found more useful than common, and it is, That divers Bodies, whether difill'd or not distill'd, that are not thought capable of dissolving other Bodies, because in moderate degrees of heat they will not work on them, may yet by intense degrees of heat be brought to be fit Solvents for To which purpose I remember, that having a distill'd Liquor, which was rather sweet to the taste, than either acid, lixiviate or urinous, though for that reason it seem'd unfit to work on Pearls, and accordingly did not dissolve them in a considerable time, wherein they were kept with it in a more than ordina. ily warm digestion; yet the Glass being for many hours (amounting perhaps to some days) kept in such an

16 Df the Werhanical Dzigine of an heat of fand as made the Liquor boil, we had a Dissolution of Pearls, that uniting with the Menstruum made it a very valuable Liquor And though the Solvents of crude Gold, wont to be employed by Chymists, are generally distill'd Liquors that are acid, and in the lately mention'd Solvent, made of crude Salts and common water, Acidity feem'd to be the predominant quality (which makes the use of Soluti. ons made in Aqua Regia, &c. ful. pected by many Physicians and Chy. mists;) yet fitly chosen Alcalizate Bodies themselves, as repugnant as they use to be to Acids, without the help of any Liquor will be enabled by a melting Fire in no long time to penetrate and tear afunder the parts even of crude Gold; fo that it may afterwards be easily to ken up in Liquors that are not acid, or even by water it felf.

EXPER. VII.

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He Tract about Salt-peter, that. gave occasion to these Annotations, may furnish its with an eminent Instance of the Production of solvents. For, though pure Saltpeter it felf, when dissolv'd in water, not observ'd to be a Menstruum for the Solution of the Metals hereister to be named, or so much as of Coral it felf; yet, when by a convenient Distillation its parts are split, fl may so speak, and by Attrition, or other Mechanical ways of workigon them, reduc'd to the shapes of Acid and Alcalizate Salts, it then fords two forts of Menstruums of very differing natures, which bewixt them dissolve or corrode a great number and variety of Bodies; the Spirit of Nitre without addiion is a Solvent for most Metals, as liver, Mercury, Copper, Lead, &c. also divers Mineral Bodies, as B 2

18 Df the Wechanical Dzigine of

Tin-glass, Spelter, Lapis Calaminaris, &c. and the fixed Salt of Nitre operates upon Sulphureous Minerals, as common Sulphur, Antimony, and divers other Bodies, of which I elsewhere make mention.

EXPER. VIII.

Y the former Trials it has ap-B pear'd, that the increase of Motion in the more penetrating Corpuscles of a Liquor, contributes much to its Solutive power; and I shall now adde, that the Shape and Size, which are Mechanical affections, and fometimes also the Solidity of the fame Corpufcles does eminently concur to qualifie a Liquor to dissolve this or that particular body. this, even some of the more familiar practices of Chymists may supply us with Instances. For there is no account so probable as may be given upon this supposition, why Aqua Fortis. which will diffolve Silver, without medling

Corrolibenels of Corrolibility. 19 medling with Gold, should, by the addition of a fourth part of its weight of Sal Armoniac, be turn'd into Aqua Regia, which, without medling with Silver, will dissolve Gold. But there is no necessity of having recourse to so gross and compounded a Body as Sal Armoniac to enable Aqua Fortis to dissolve Gold: For. the Spirit of common Salt alone being mingled in a due proportion, will fuffice for that purpose. Which (by the way) shews, that the Volatile Salt of Urine and Soot, that concur to the making up of Sal Armoniac, are not necessary to the dissolution of Gold, for which a Solvent may bemade with Aqua Fortis and crude Sea-salt. I might adde, that the Mechanical affections of a Menstruum may have fuch an interest in its disblutive power, that even Mineral or Metalline Corpuscles may become uleful Ingredients of it, though perhaps it be a distill'd Liquor; as might beillustrated by the Operations of ome compounded Solvents, such as is

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is the Oyl of Antimony made by repeated Rectifications of what Chymists call its Butter, which, whatever some say to the contrary, does much abound in Antimonial Substance.

EXPER. IX.

Ut I shall return to our Aqua Regia, because the mention I had occasion to make of that Solvent brought into my mind what I devisid, to make it probable, that a fmaller change, than one would lightly imagine, of the bulk, shape, or folidity of the Corpuscles of a Menstruum may make it fit to diffolve a Body it would not work on before. And this I the rather attempted, because the warier sort of Chymists themselves are very sye of the inward use or preparations made of Gold by the help of Aqua Fortis, because of the odious stink they find, and the venenosity they Suspect

Cozrolibenels oz Cozrolibility. 21 infeet in that corrofive Menstruum: Whereas Spirit of Salt we look upon as a much more innocent Liquor, whereof, if it be but diluted with fair water or any ordinary drink, agood Dose may be safely given inwardly, though it have not wrought upon Gold or any other body, to take off its acrimony. But, whether or no this prove of any great use in Physick, wherein perhaps, if any quantity of Gold be to be dissolred, a greater proportion of Spirit of Nitre would be needed; the fuces will not be unfit to be mention'd in reference to what we were laying of Solvents. For, whereas we find not that our spirit of salt here in England will at all dissolve ande Gold, we found, that by puting some Leaf-gold into a convenient quantity of good Spirit of Salt, when we had dropt-in Spirit of Nitte (shaking the Glass at each drop,) ill we perceived, that the mixture was just able in a moderate heat to discolve the Gold, we found, that

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22 Df the Bechanical Dzigine of we had been oblig'd to employ but after the rate of twelve drops of the latter Liquor to an ounce of the former ; fo that, supposing each of these drops to weigh a grain, the fortieth part of Spirit of Nitre being added. ferved to turn the Spirit of Salt into a kind of Aqua Regia. But to know the proportion otherwise than by ghess, we weigh'd six other drops of the same Spirit of Salt, and found them to amount not fully to three grains and an half: Whence it appeared; that we added but about a seventieth part of the Nitrous Spirit to that of Salt.

The Experiments that have been hitherto recited, relate chiefly to the Production of Corrofive Menstrums; and therefore I shall now adde an account of a couple of Trials, that I made manifestly to lessen or quite to destroy Corrofiveness in Liquors very conspicuous for that quality.

EXPER. X.

7Hereas one of the most corrosive Menstruums, that is vet known, is Oyl of Vitriol, which will fret in pieces both divers Metals and Minerals, and a great number and variety of animal and vegetable bodies; yet if you digest with it for a while onely an equal weight of highlyrectified Spirit of Wine, and afterwards distill the mixture very warily, (for else the Experiment may veny eafily miscarry,) you may obtain a pretty deal of Liquor not corrolive atall, and the remaining substance will be reduc'd partly into a Liquor, which, though acid, is not more fo than one part of good Oyl of Vitriol will make ten times as much common water, by being well mingled with it; and partly into a dry substance that has scarce any taste at all, much less a corrosive one.

EXPER. XI.

Nd though good Aqua Fortishe the most generally employed of corrolive Menstruums, as being capable of dissolving or corroding, not onely many Minerals, as Tinglass, Antimony, Zinke, &c. but all Metals except Gold, (for, thoughit make not a permanent Solution of crude Tin, it quickly frets the parts afunder, and reduces it to an immalleable substance;) yet to shew, how much the power of corroding may be taken away by changing the Mechanical Texture of a Menstruum, even without seeming to destroy the fretting Salts, I practis'd (and communicated to divers Virtuofi) the following Experiment, elsewhere mentioned to other purposes.

We took equal parts of good Aqua Fortis, and highly dephlegm'd Spirit of Wine, and having mingled them warily and by degrees, (with-

Corrosibenels of Corrosibility. 25 (without which caution the Operation may prove dangerous,) we united them by two or three Distillations of the whole mixture; which afterwards we found not to have the last fretting taste, and to be so degived of its corrolive nature, that it would not work upon Silver, though by Precipitation or otherwise reduc'd to very small parts; nay, it would scarce sensibly work in a good while on Filings of Copper, or upmother bodies, which meer Vinegr, or perhaps Rhenish wine will orrode. Nay, I remember, that with nother Spirit, (that was not Uri-1018) and afterwards with Alkool of Wine we shew'd a more surpriing specimen of the power of eiher destroying or debilitating the Corrolivenels of a Menstruum, and checking its Operation. For, having caused a piece of Copper-plate to be put into one ounce of Aqua Fortis, when this Liquor was eagerly working upon the Metal, I caus'd mounce of the Alkool of Wine, or the the other Spirit to be poured, (which it should warily be) upon the agitated mixture; whose effervescence, at the first instant, seemed to be much increased, but presently after was checked, and the Corrosiveness of the Menstruum being speedily disabled or corrected, the remaining Copper was left undissolved at the bottom.

Nor are these the onely acid Menstruums that I have many years since been able to correct by such a way: For I applied it to others, as Spirit of Nitre, and even Aqua Regis it self; but it has not an equal operation upon all, and least of all (as sar as I can remember) upon Spirit of Salt; as on the other side strong Spirit of Nitre was the Menstruum upon which its effects were the most satisfactory.

Most of the Chymists pretend, that the Solutions of bodies are perform'd by a certain Cognation and Sympathy between the Menstruum and the body it is to work upon

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Corrosibenels of Corrosibility. 27 And it is not to be denied, that in divers Instances there is, as it were, a Confanguinity between the Menfruum and the body to be dissolved \$ when Sulphur is dissolved by Oyls whether exprest or distill'd: But yet, as the opinion is generally proposed, I cannot acquiesce in its partly because there are divers Soations and other Phanomena, where i will not take place, and partly because even in those instances wherein 'tis thought most applicable, the effect feems to depend upon Medanical Principles.

EXPER. XII.

A Nd first, twill be difficult to shew, what Consanguinity there is between Sal Gem, and Antimony, and Iron, and Zinke, and Bread, and Camphire, and Lapis Calaminaris, and slesh of divers kinds, and Oister-shels, and Harts-horn, and Chalk, and Quick-lime; some of which bealong

ong to the Dechanical Designess ong to the Vegetable, some to the Mineral, and some to the Animal Kingdom; and yet all of them and divers others (as I have tried) may, even without the assistance of external Heat, be dissolved or corroded by one single Mineral Menstruum, Oyl of Vitriol. And which is not to be neglected on this occasion, some of them may be bodies, supposed by Chymists to have an Antipathy to each other in point of Corrosson or Dissolution.

EXPER. XIII.

I Observe also, that a Dissolution may be made of the same body by Menstruums, to which the Chymists attribute (as I just now observed they did to some Bodies) a mutual Antipathy, and which therefore are not like to have a Sympathy with the same third body; as I found by trial, that both Aqua Fortis, and Spirit of Urine, upon whose mixture

toprolibenels of Corrolibility. 29 me there insues a conflict with a meat effervescence, will each of hem apart readily dissolve crude linke, and so each of them will, the filings of Copper. Not to mention, hat pure Spirit of Wine and Oyl of Vitriol, as great a difference as there between them, in I know not how many respects, and as notable a heat s will insue upon their Commixme, will each of them dissolve Camphire; to which may be added other instances of the like nature: hs for what is commonly faid, that Oyls diffolve Sulphur, and Saline Menstruums Metals, because (as they speak) Simile simili gaudet: I nswer. That where there is any sich similitude, it may be very probibly ascribed, not so much, with the Chymists that favour Aristotle, to the essential forms of the bodies that are work on each other, nor, with the beer Chymists, to their Salt, or Sulphur, or Mercury, as such; but to the congruity between the pores ind figures of the Menstruum, and the

30 Of the Bechanical Dzigine of the body dissolved by it, and to some other Mechanical Affections of them.

EXPER. XIV.

Por Silver, for example, not onely will be dissolved by Nitre which they reckon a Salt, but be amalgam'd with, and consequently dissolved by, Quicksilver, and also by the operation of Brimstone, be easily incorporated with that Mineral which Chymists are wont to account of so oleaginous a nature, and insoluble in Aqua Fortis.

EXPER. XV.

And as for those Dissolutions that are made with Oylie and inflammable Menstruums, of common Sulphur and other inflammable bodies, the Dissolution does not make for them so clearly as they imagine.

Corrolibenels of Corrolibility. 31 imagine. For if such Menstruums operate, as is alledged, upon the account of their being, as well as the bodies they work upon, of a sulphureous nature, whence is it that highly rectified Spirit of Wine, which according to them must be of a most sulphureous nature, fince being fet on fire 'twill flame all away without leaving one drop behind it, will not (unless perhaps after a tedious while) dissolve even Flowers of himstone, which essential as well sexpress'd Oyls will easily take up \$ aspirit of Wine it self also will do amost in a trice, if (as we shall see mon) by the help of an Alcali the Texture of the Brimstone be alter'd, though the onely thing that is added to the Sulphur being an incombustible substance, is nothing near of fo fulphureous a nature as the flowers, and need have no Confanminity upon the score of its Origine with Spirit of Wine, as 'tis ledged that Salt of Tartar has; ince I have tried, That fixt Nitre, em-

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32. Df the Bechanical Dzigine of employ'd instead of it, will do the same.

EXPER. XVI.

He mention of Nitre brings into my mind, that the Salt-peter being wont to be lookt upon by Chymists as a very inflammable body, ought, according to them, to be of a very sulphureous nature; yet we find not that 'tis in Chymical Oyls, but in water, readily dissolved. And whereas Chymists tell us, that the Solutions of Alcaly's, fuch as Salt of Tartar, or of Potashes in common Oyls, proceed from the great cognation between them, I demand, whence it happens, that Salt of Tartar will by boiling be dissolved in the exprest Oyl of Almonds, or of Olives, and be reduc'd with it to a foapy body, and that yet with the effential Oyl of Juniper or Aniseeds, &c. where what they call the Sulphur is made pure and

Corrolibenels of Corrolibility. 33 and penetrant, being freed from the earthy, aqueous and feculent parts. which Distillation discovers to be in the exprest Oyls, you may boil Salt of Tartar twenty times as long without making any Soap of them, or perhaps any sensible Solution of the Alkaly. And Chymists know, how difficult it is, and how unfucresfully 'tis wont to be attempted to dislove pure Salt of Tartar in pure spirit of Wine, by digesting the not peculiarly prepar'd Salt in the ognate Menstruum. I will not urge, that, though the most conspicuous mark of Sulphur be inflammability, nd is in an eminent degree to be found in Oyl as well as Sulphur; yet an Alkaly and water which are wither singly, nor united inflam.

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EXPER. XVII.

Dut to make it probable against the Chymists, (for I propose it but as an argument ad hominem) that the Solution of Sulphur in exprest Oyls depends upon somewhat else besides the abundance of the second Principle in both the bodies; I will adde to what I said before, an affirmation of divers Chymical Writers themselves, who reckon Aqua Regis, which is plainly a Saline Menstruum, and dissolves Copper, Iron, Coral, &c. like Acid Liquors, among the Solvents of Sulphur, and by that power among other things distinguish it from Aqua Fortis. And on the other side if, there be a Congruity betwixt an exprest Oyl and another body, though it be such as, by its easie Dissolubleness in Acid Salts, Chymilts thould pronounce to be of a faline nature, an exprest Oyl will readily enough work apon It,

Corrolibenels of Corrolibility. 35 it; as I have tried by digesting even crude Copper in Filings with Oyl of sweet Almonds, which took up so much of the metal as to be deeply coloured thereby, as if it had been a Corrolive Liquor: Nay, I shall adde, that even with Milk, as mild a Liquor as 'tis, I have found by Trial, that without the help of fire akind of Dissolution may, though not in few hours, be made of crude Copper, as appear'd by the greenih blew colour the Filings acquired, when they had been well drenched in the Liquor, and left for a certain time in the Vessel, where the ir had very free access to them.

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EXPER. XVIII.

Esides the Argument ad hominem, newly drawn from Aqua Regia, it may be proper enough to urge another of the same kind upon the generality of the Helmontians and Par racelsans, who admit what the Heads of their Seas deliver concerning the Operations of the Alkaheft. For whereas 'tis affirm'd, that this irrefistible Menstruum will dissolve all tangible bodies here below, so as they may be reduc'd into infipid water; as on the one fide 'twill be very hard to conceive how a specificated Menstruum that is determin'd to be either Acid, or Lixiviate, or Urinous, &c. should be able to dissolve so great a variety of Bodies of differing and perhaps contrary natures, in some whereof Acids, in other Lixiviate Salts, and in others Urinous are predominant; so on the other side, if the Alkahest be not a speci-

corrolibenels of Corrolibility. 37 pecificated Menstruum, 'twill very much disfavour the Opinion of the Chymists, that will have some Bodies dissoluble onely by Acids as such, others by fixt Alkalys, and others again by Volatile Salts; fince Menstruum, that is neither Acid, Lixiviate, nor Urinous, is able to dissolve bodies, in some of which me, and in others another of those Principles is predominant: So that, f a Liquor be conveniently qualified, it is not necessary that it should beither Acid to dissolve Pearl or Coral, or Alkalizate to dissolve Sulohur. But upon what Mechanical mount an analyzing Menstruum may operate, is not necessary to be here determin'd. And I elsewhere offer ome thoughts of mine about it.

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EXPER. XIX.

F we duly reflect upon the known process that Chymists are wont to employ in making Morcurius dul. cis, we shall find it very favourable to our Hypothesis. For the we have already thewn in the V. Theriment, and 'tis generally confident that common Sublimate made of Mercury is a highly corrofive body; yet, if it be well ground with near an equal weight of Quickfilver, and be a few times sublimed, (to mix them the more exactly) it will become so mild, that 'twill not fo much as tafte sharp upon the tongue; so that Chymists are wont to call it Mercurius dulcis: And yet this Dulcification seems to be performed in a Mechanical way. For most part of the Salts, that made the Sublimate fo Corrofive, abide in the Mercurius dulcis; but by being compounded with more Quickfilver, they

Corrolivenels of Corrolivility. 39 they are diluted by it, and (which is more considerable) acquire a new Texture, which renders them unfit to operate, as they did before, when the fretting Salts were not joyn'd with a sufficient quantity of the Mercury to inhibit their corrofive activity. It may perhaps somewhat help us to conceive, how this change may be made, if we imagine, that a company of meer Knifeblades be first fitted with Hafts. which will in some regard lessen their wounding power by covering or casing them at that end which is design'd for the handle; (though their insertion into those Hafts, turning them into Knives, makes them otherwise the fitter to cut and pierce) and that each of them be afterwards heathed, (which is, as it were, a hasting of the Blades too;) for then they become unfit to cut or stab, as before, though the Blades be not destroyed: Or else we may conceive these Blades without Hasts or Sheaths to be tied up in bundles,

40 Of the Wechanical Dzigine of or as it were in little faggots with pieces of wood, fomewhat longer than themselves, opportunely placed between them. For neither in this new Constitution would they be fit to cut and stab as before. And by conceiving the edges of more or fewer of the Blades to be turn'd inwards, and those that are not, to have more or less of their points and edges to be sheath'd, or other-wise cover'd by interpos'd bodies, one may be help'd to imagine, how the genuine effects of the Blades may be variously lessen'd or diversifi'd. But, whether these or any other like changes of Disposition be fancy'd, it may by Mechanical Illustrations become intelligible, how the Corrofive Salts of common Sublimate may lose their efficacy, when they are united with a sufficient quantity of Quickfilver in Mercuri-us dulcis: In which new state the Salts may indeed in a Chymical phrase be said to be satiated; but this Chymical phrase does not explicate

Corrosivenels of Corrosivility. 41 olicate how this Saturation takes away the Corroliveness from Salts that are still actually present in the weet Mercury. And by Analogy to some such Explications as the above propos'd, a possible Account may be render'd, why fretting Salts weither quite lose their sharpness, as Alkalies, whilft they are imbodied with Sand in common Glass; or lose much of their Corrosive Acidiy, as Oyl of Vitriol does when with Steel it composes Vitriolum Martis; or else are transmuted or disguis'd by conjunction with some orroded bodies of a peculiar Textere, as when Aqua Fortis does with Silver make an extreamly bitter Salt or Vitriol, and with Lead one that is positively sweet almost like common Saccharum Saturni.

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42 Df the Mechanical Dzigine of

EXPER. XX.

O shew, how much the Efficacy of a Menstruum may depend even upon such seemingly slight Mechanical Circumstances as one would not easily suspect any necessity of, I shall employ an Experiment, which though the unpractis'd may easily fail of making well, yet, when I tried it after the best manner, I did it with good success. I put then upon Lead a good quantity of well rectified Aqua Fortis, in which the Metal, as I expected, continued undissolved; though, if the Chymists fay truly that the dissolving power of the Menstruum consists onely in the acid Salts that it abounds with, it seems naturally to follow, that the more abundance of them there is in a determinate quantity of the Liquor, it should be the more powerfully

Corrolivenels of Corrolivitity. 43 fully able to dissolve Metalline and Mineral bodies. And in effect we fee, that, if Corrofive Menstruums he not fufficiently dephlegmed. hey will not work on divers of hem. But, notwithstanding this dausible Doctrine of the Chymilts, conjecturing that the Saline Particles that swam in our Aqua Fortis might be more throng'd toether, than was convenient for a body of fuch a Texture of Saline parts, and fuch intervals between them, I diluted the Menstruum by adding to it what I thought fit of air water, and then found, that the defired Congruity betwixt the Agent and the Patient emerged, and the Liquor quickly began to fall mon the Metal and dissolve it. And fyou would try an Experiment to he same purpose, that needs much les circumspection to make it succed, you may, instead of employing Lead, reiterate what I elsewhere mention my self to have tried with Silver. Silver, which would not dissolve in too strong Aqua fartis, but would be readily fallen upon by that Liquor, when I had weaken'd it with common water.

And this it may suffice to have said at present of the power or faculty that is found in some bodies of Corroding or Dissolving others. Whereof I have not found among the 4. ristotelians, I have met with, so much as an Offer at an Intelligible account. And I the less exped the vulgar Chymists will from their Hypostatical Principles afford us a Satisfactory one, when, befides the Particulars that from the nature of the things and Helmout's Writings have been lately alledg'd against their Hypothesis, I consider, how slight accounts they are wont to give us even of the familiar Phenomena of Corrofive Liquors. For if, for example, you ask a vulgar Chymist why Aqua fortis dissolves Silver and Copper,

Correlivenels of Corrolivility. 45 is great odds but he will tell you, is because of the abundance of freting Salt that is in it, and has a cognation with the Salts of the Metal. And if you ask him, why Spirit of Salt dissolves Copper, he will tell you 'tis for the same reason; and yet, f you put Spirit of Salt, though very strong, to Aqua fortis, this Liquor will not dissolve Silver, because upon the mixture, the Liquors equire a new Gonstitution as to the Saline Particles, by vertue of which the mixture will dissolve, instead of Silver, Gold. Whence we may arme against the Chymists, that the loability of this compounded Liquor work on Silver does not proceed from its being weaken'd by the Spiit of Salt; as well because, according to them, Gold is far the more compact metal of the two, and requires a more potent Menstruum to work upon it, as because this same compounded Liquor will readily difblve Copper. And to the same purpole

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pose with this Experiment I should alledge divers others, if I though this the fittest place wherein I could propose them.

SECT.

Corrolibenels and Corrolibility. 47

SECT. II.

About the Mechanicall Origine of CORRO-SIBILITY.

that answers Corrosiveness, he that has taken notice of the Advertisement I formerly gave about my use of the Term Corrosiveness See the beginning of the first Scation.

In these Notes, may taily judge, in what sense I employ the name of the other Quality; which (whether you will stile it Opposite or Conjugate) for want of a better word, I call Corrosibi-

This Corrosibility of Bodies is as well as their Corrosiveness a Relative thing; as we see, that Gold, in instance, will not be dissolved by

lity.

48 Of the Wechanical Dzigine of

by Aqua fortis, but will by Aqua Regis; whereas Silver is not soluble by the latter of these Menstruums, but is by the former. And this relative Affection, on whose account a Body comes to be corrodible by a Menstruum, seems to consist chiefly in three things, which all of them depend upon Mechanical Prin-

ciples.

Of these Qualifications the first is, that the Body to be corroded be furnish'd with Pores of such a bigness and figure, that the Corpucles of the Solvent may enter them, and yet not be much agitated in them without giving brisk knocks or shakes to the solid parts that make up the walls, if I may so call them, of the Pores. And 'tis for want of this condition, that Glass is penetrated in a multitude of places, but not dissipated or dissolv'd by the incident beams of Light, which permeate its Pores without any confiderable ref. stance; and though the Pores and Commissures of a Body were less miCorrolibenels and Corrolibility. 49

minute, and capable of letting in some grosser Corpuscles, yet if these were, for want of solidity or rigidness, too slexible, or were of a sigure incongruous to that of the Pores they should enter, the Dissolution would not insue; as it happens when pure Spirit of Wine is in the cold put upon Salt of Tartar, or when Aqua fortis is put upon powder

of Sulphur.

The fecond Qualification of a Cornotible Body is, that its confiftent Corpuscles be of such a Bulk and folidity, as does not render them mapable of being disjoyn'd by the thion of the infinuating corpufcles of the Menstruum. Agreeable to his and the former Observation is he practice of Chymists, who ofmimes, when they would have a lody to be wrought on by a Menmum otherwise too weak for it in scrude estate, dispose it to receive raction of the Menstruum by preoully opening it, (as they speak) the is, by enlarging the Pores, ma-D 2 king king

50 Df the Wechanical Dzigine of king a comminution of the Corpuscles, or weakening their Cohesion. And we see, that divers Bodies are brought by fit preparations to berefoluble in Liquors that would not work on them before. Thus, as was lately noted, Lime-stone by Calcination becomes (in part) dissoluble in water; and some Metalline Calces will be so wrought on by Solvents, as they would not be by the same Agents, if the preparation of the Metalline or other Body had not given them a new Disposition. Thus, though crude Tartar, especially in lumps, is very flowly and difficultly dissoluble in cold water, yet when 'cis burnt it may be presently dissolved in that Liquor; and thus, though the Filings and the Calx of Silver will not be at all dissolv'd by common water or Spirit of Wine; yet if by the interpolition of the Saline Particles of Aqua Fortis, the Lunar Corpuscles be so disjoyn'd, and fuffer fuch a comminution as they do an Crystals of Lune, the Metal thus

prepared and brought with its Saline Additament into a new Texture will easily enough dissolve, not onely in water, but, as I have tried, in well restified Spirit of Wine. And the like Solubility I have found in the Crystals of Lead made with Spirit of Verdigrease, or good diffill'd Vinegar, and in those of Cop-

per made with Aqua Fortis.

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The last Disposition to Corrosibility confilts in fuch a cohesion of the parts, whereof a Body is made up, as is not too strict to be superable by the action of the Menstruum. This Condition, though of kin to the former, is yet somewhat differing from it, fince a body may conlit of parts either bulky or folid, which yet may touch one another in fuch small portions of their Surlaces, as to be much more easily diflociable than the minute or less solid parts of another Body, whose contact is more full and close, and fo their Cohesion more strict.

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By what has been said it may seem probable, that, as I formerly intimated, the Corrosibility of Bodies is but a Mechanical Relation, resulting from the Mechanical Affections and Contexture of its parts, as they intercept Pores of such sizes and figures as make them congruous to those of the Corpuscles of the Menstruum, that are to pierce between them, and disjoyn them.

That the Quality, that disposes the body it affects to be dissolv'd by Corrofive and other Menstruums, does (as hath been declared) in many cases depend upon the Mechanical Texture and Affections of the body in reference to the Menstruum that is to work upon it, may be made very probable by what we are in due place to deliver concerning the Pores of Bodies and Figures of Corpuscles. But yet in compliance with the design of these Notes, and agreeably to my custom on other Subjects, I shall subjoyn a few Experiments on this occasion also. EX.

EXPER. I.

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IF we put highly rectified Spirit of Wine upon crude Sulphur, or even Flowers of Sulphur, the Liquor will lie quietly thereon, especially in the cold, for many hours and days without making any visible Solution of it; and if such exactly dephlegmed Spirit were put on very dry Salt of Tartar, the Salt would lie in an undisfolved powder at the bottom: and yet, if before any Liquor be employed, the Sulphur be gently melted, and then the Alkali of Tartar be by degrees put to it, and incorporated with it; as there will result a new Texture discoverable to the eye by the new colour of the Composition, so there will emerge a disposition that was not before in either of the Ingredients, to be dissolved by Spirit of Wine; insomuch, that though the mixture be kept till it be quite cold, D 4 70

or long after too, provided it be carefully secur'd from the access of the air, the Spirit of Wine being put to it, and shaken with it, will, if you have gone to work aright, acquire a yellow Tincture in a minute of an hour; and perhaps in less than half a quarter of an hour a red one, being richly impregnated with sulphureous Particles discoverable by the Smell, Taste, and divers Operations.

EXPER. II.

mists, that Spirit of Salt does not dissolve crude Mercury in the cold; and I remember, I kept them for a considerable time in no contemptible heat without sinding any Solution following. But I suppose, many of them will be gratified by an Experiment once mention'd to me by an Ingenious German Gentleman, namely, That if Mercury be

be precipitated per se, that is, reduc'd to a red powder without additament, by the meer operation of the fire, the Texture will be so chang'd, that the above-mention'd spirit will readily dissolve it; for I sound it upon Trial to do so; nay, sometimes so readily, that I scarce remember that I ever saw any Menstrum so nimbly dissolve any Metalline body whatsoever.]

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EXPER. III.

The former Experiment is the more remarkable, because, that though Oyl of Vitriol will in a good heat corrode Quicksilver, (as we have already related in the first Section,) yet I remember I kept a Precipitate per se for divers hours in a considerable degree of Heat, without finding it to be dissolved or corroded by the Menstruum. And yet having, sor trials sake, put another parcel of the same Mercurial power.

of De the Bechanical Deigine of der into some Aqua fortis, or Spirit of Nitre, there insued a speedy Difformation even in the cold.

And that this Disposition to be dissolved by Spirit of Salt, that Mercury acquires by being turned in. to Precipitate per se, that is, by being calcin'd, is not meerly the effect of the operation of the fire upon it, but of some change of Texture produced by that Operation; may be probably argued from hence, that, whereas Spirit of Salt is a very proper Menstruum, as I have often tried, for the diffolving of Iron or Steel; yet, when that Metal is reduced by the action of the fire (especially if a kind of Vitrification, and an irroration with distill'd Vinegar have preceded) to Crocus Martis, though it be thereby brought to a very fine powder, yet I found not, that, as Spirit of Salt will readily and with heat and noise dissolve Filings of Mars, so it would have the same or any thing near fuch an Operation upon the Crocus: but

Corrolibenels and Corrolibility. 57 but rather, after a good while, it would leave in the bottom of the Glass a considerable, if not the greatest, part of it scarce, if at all, lensibly alter'd. And the Menstruum seem'd rather to have extracted a Tincture, than made an ordinary Solution; fince the colour of it was a high yellow or reddish, whereas Mars, dissolved in Spirit of Salt, affords a green Solution. Whether by repeated Operations with fresh Menstruum further Dissolutions might in time be made, I had not occasion to try, and it may suffice for our present purpose, that Mars by the operation of the fire did evidently acquire, not, as Mercury had done, a manifest facility, but on the contrary, a great indisposition to be dissolved by Spirit of Salt.

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To second this Experiment, we vary'd it, by employing, instead of Spirit of Salt, strong Oyl of Vitriol, which being pour'd on a little Crocus Martis made per se, did not, as that Menstruum is wont to do up-

on Filings of crude Mars, readily and manifestly fall upon the powder with froth and noise, but (on the contrary) rested for divers hours calmly upon it, without so much as producing with it any sensible warmth.

EXPER. IV.

T agrees very well with our Doctrine about the dependance of the Corrosibility of Bodies upon their Texture, that from divers Bodies, whilst they are in conjunction with others, there refult maffes, and those homogeneous as to sense, that are easily dissoluble in Liquors, in which a great part of the matter, if it were separated from the rest, would not be at all dissolved. Thus we see, that common Vitriol is eafily distolved in meer water; whereas if it be skilfully calcin'd, it will vield fometimes near half its first weight of infipid Colcothar, which not

Corrolivenels and Corrolivility. 59 not onely is not foluble in waterbut which neither Aqua Fortis no Agna Regis, though sometimes there will colour themselves upon it, are able (as far as I have tried) to make Solutions of. We see like-wise, that simple water will, being boil'd for a competent time with Harts-horn, dissolve it and make a lelly of it: And yet, when we have aken Harts-horn throughly calcin'd to whiteness, not onely we found that common water was no longer a fit Solvent for it, but we observed, that when we put Oyl of Vitriol it felf upon it, a good part of the white powder was even by that Corrofive Menstruum left undisfolved.

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EXPER. V.

N the Fifteenth of the foregoing Experiments I refer to a way of making the Flower or Powder of common Sulphur become easily disso. luble, which otherwise 'tis far from being, in highly rectified Spirit of Wine. Wherefore I shall now adde, that 'cis quickly perform'd by gent-ly melting the Sulphur, and incorporating with it by degrees an equal or a greater weight of finely powder'd Salt of Tartar, or of fixt Nitre. For if the mixture be put warm into a Mortar that is fo too; and as foon as 'tis reduc'd to powder, be put into a Glass, and well shaken with pure Spirit of Wine, it will, (as perhaps I may have elsewhere observed,) in a few minutes acquire a yellow colour, which afterwards will grow deeper, and manisest it self by the smell and effects to be a real Solution of Sulphur; and

toprofibenels and Coprofibility. 61 and yet this Solubleness in Spirit of Wine feems procur'd by the change of Texture, resulting from the Commixtion of meer Salt of Tartar, which Chymists know, to their mouble, to be it self a body almost s difficult as Sulphur to be dissolved in phlegmless Spirit of Wine, mless the Constitution of it be first alter'd by some convenient additament. Which last words I adde, because, though Spirit of Verdigrease be a Menstruum that uses to come off in Distillation much more intirewithan other acid Menstruums from the bodies it has dissolved; yet it will serve well for an additament to open (as the Chymists speak) the body of the Salt of Tartar. For this purpose I employ Spirit of Verdigrease, not made first with Spirit of Vinegar, and then of Wine, after the long and laborious way prescribed by Basilius and Zwelfer, but easily and expeditiously by a simple Di-stillation of crude Verdigrease of the better fort. For when you have with

with this Liquor (being, if there be need, once rectified) dissolvid as much good Salt of Tartar, as 'twill take up in the cold, if you draw off the Menstruum ad siccitatem, the remaining dry Salt will be manifestly alter'd in Texture even to the eye, and will readily enough in high rectified Spirit of Wine afford a Solution, which I have found considerable in order to divers uses that concern not our present Discourse.

EXPER. VI.

lowers of Helmont I shall recommend an Experiment of that famous Chymist's, which seems to sute exceeding well with the Doctrine propos'd in this Section. For he tells us, that, if by a subtle Menstruum to which he ascribes that power. Quicksilver be devested (or depriv'd) of its external Sulphur, as he terms it, all the rest of the sluid Metal,

Corrofibenels and Corrofibility. 63 Metal, which he wittily enough stiles, the Kernel of Mercury, will be no longer corrofible by it. So that upon this Supposition, though common Quickfilver be observ'd to be so obnoxious to Aqua Fortis, that the same quantity of that Liquor will dissolve more of it, than of any other Metal; yet, if by the deprivation of some portion of it the dent Texture of the Metal be alter'd, though not (that I remember) the visible appearance of it; the Body that was before so easily dissolved by Aqua Fortis, ceases to be at all dissoluble by it.

EXPER. VII.

As for those Chymists of differing Sects, that agree in giving redit to the strange things that are strm'd of the Operations of the Alkahest, we may in favour of our Doctrine urge them with what is deliver'd by Helmont, where he asserts,

64 Of the Wechanical Dzigine of

ferts, that all folid Bodies, as Stones, Minerals, and Metals themselves, by having this Liquor duly abstracted or distill'd off from them, may be changed into Salt, equiponderant to the respective bodies whereon the Menstruum was put. So that suppoling the Alkahest to be totally abstracted, (as it seems very probable to be, fince the weight of the body whence 'twas drawn off is not alter'd;) what other change than of Texture can be reasonably imagin'd to have been made in the transmuted bodies? and yet divers of them, as Flints, Rubies, Saphyrs, Gold, Silver, &c. that were infoluble before, some of them in any known Menstruums, and others in any but Corrofive Liquors, come to be capable of being dissolv'd in common water.

EXPER. VIII.

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Is a remarkable Phanamenon, that fuits very well with our opinion about the interest of Mechanical Principles in the Corrofive Power of Menstruums, and the Corrofibility of bodies, that we produc'd by the following Experiment: This we purposely made to shew, after how differing manners the same body may be diffolv'd by two Menfruums, whose minute parts are very differingly constituted and agitated. For whereas 'tis known, that if we put large grains of Sea-salt into common water, they will be diffolved therein calmly and filently without any appearance of conflict; If we put such grains of Salt into good Oyl of Vitriol, that Liquor will fall furiously upon them, and produce for a good while a hiffing noise with fumes, and a great store of bubbles, as if a potent Menstru-E 2

um were corroding some stubbom metal or mineral. And this Experiment I the rather mention, because it may be of use to us on diversother occasions. For else 'tis not the onely, though it be the remarkablest, that I made to the same purpose.

EXPER. IX.

Or, whereas Aqua Fortis or Aqua Regis, being pour'd upon Filings of Copper, will work upon them with much noise and ebullition, I have tried, that good Spirit of Sal Armoniac or Urine, being put upon the like Filings, and left there without Stopping the Glass, will quickly begin to work on them, and quietly diffolve them almost as water disfolves Sugar. To which may be added, that even with Oyl of Turpentine I have, though but slowly, dissolved crude Copper; and the Experiment seemed to favour our Conjecture the more, because having tried it several times, it appear'd,

pear'd, that common unrectified Oyl would perform the Solution much quicker than that which was purified and subtiliz'd by rectification; which though more subtle and penetrant, yet was, it seems, on that account less fit to dissolve the Metal, than the grosser Oyl whose particles might be more solid or more advantageously shap'd, or on some other Mechanical account better qualified for the purpose.

EXPER. X.

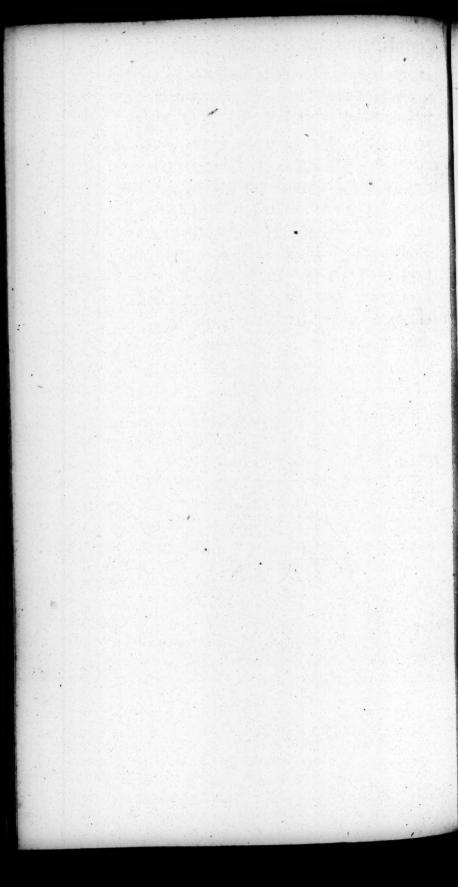
TAke good Silver, and, having dissolved it in Aqua Fortis, preipitate it with a sufficient quantity of good Spirit of Salt; then having wash'd the Calx, which will be very white, with common water, and dridit well, melt it with a moderate fire into a susible Mass, which will be very much of the nature of what Chymists call Cornu Lunæ, and which they make by precipitating dissolv'd E 2 Sil.

68 Of the Wechanical Dzigine of Silver with a bare Solution of common Salt made in common water, And whereas both Spirit of Salt and Silver dissolv'd in Aqua Fortis will each of them apart readily diffolve in simple water, our Luna Corneanot onely will not do fo, but is fo indifpos'd to Dissolution, that I remember I have kept it in Digestion, some in Aqua fortis, and some in Aqua Regia, and that for a good while, and in no very faint degree of heat, without being able to dissolve it like a Metal, the Menstruums having indeed ting'd themselves upon it, but left the Composition undissolv'd at the bottom.

With this Instance (of which sort more might be afforded by Chymical Precipitations) I shall conclude what I design'd to offer at present about the Corrosibility of Bodies, as it may be consider'd in a more general way. For as to the Disposition that Particular Bodies have of being dissolved in, or of resisting, Determinate Liquors, it were much

easier for me to enlarge upon that Subject, than it was to provide the Instances above recited. And these are not so sew, but that 'tis hop'd they may suffice to make it probable, that in the Relation betwixt a Solvent and the Body it is to work upon, that which depends upon the Mechanical affections of one or both, is much to be considered, and has a great interest in the operations of one of the bodies upon the other.

FINIS.



MECHANICAL CAUSES

OF

CHYMICAL

PRE CIPITATION.

By the Honourable ROBERT BOYLE Efq;

Fellow of the R. Society.

LONDON:

bild by Sam. Smith, at the Prince's Arms in Sr. Paul's Church-Yard. 1690.

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Hough I Shall not deny, that, in Grammatical strictness, Precipitation should be reckoned among Chymical Operations, not Qualities, yet I did not much scruple to insert the following Discourse among the Notes about Particular Qualities, because many, if not most, of the Phænomena, mentioned in the ensuing Essay, may be considered as depending, some of them, upon a power, that certain bodies have to cause Precipitation, and some upon such a Disposition to be struck down by others, as may, if men please, be called Precipitability. And so these differing Affections may with (at least) toletable Congruity be referred to those that we have elsewhere stiled Chymical Qualities. A 2 BHÁ

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But though I hope, I may in the fe few Lines have Said enough concerning the name given to these Attributes, yet perhaps it will be found in time, that the things themselves may deserve a larger Discourse than my little leasure would allow them. For that is not a causeless Intimation of the Importance of the Subject, wherewith I conclude the following Tract, since besides that many more Instances might have been particularly referred to the Heads treated of in the Insuing Essay, there are improper kinds of Precipitation (besides shofe mentioned in the former part of the Discourse) to which one may not incongruously refer divers of the Phanomena of Nature, as well in the greater as in the leffer world, whereof either no Canses at all, or but improper ones are wont to be given. And besides the simple Spirits and Salts usually employed by Chymists, there are many compounded and decompounded bodies not only factitions but natural, (and Some juch as one would Searce suspect) that may in congruous subjects produce Such

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such Precipitations, as I speak of. And the Phænomena and Consequents of such operations may in divers cases prove conducive both to the Discovery of Physical Causes, and the Production of useful effects; though the particularizing of such Phænomena do rather helong to a History of Precipitations, than to such a Discourse as that which follows, wherein I proposed not so much to deliver the latent Mysteries, as to investigate the Mechanical Causes of Precipitation.

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MECHANICAL CAUSES

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PRECIPITATION.

CHAP. I.

BY Precipitation is here meant such an agitation or motion of a heterogeneous liquor, as in no long time makes the parts of it subside, and that usually in the form of a powder or other consistent body.

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As, on many occasions, Chymists call the substance that is made to sall to the bottom of the liquor, the Precipitate; so for brevity sake we shall call the body that is put into the siquor to procure that subsiding, the Precipitant; as also that which is to be struck down, the Precipitable substance or matter, and the liquor where in it swims before the separation, the Menstruum or Solvent.

When a hasty sall of a heterogeneous body is procured by a Precipitant, the Operation is called Precipitation in the proper or strict sense: But when the separation is made without any such addition, or the substance, separated from the fluid part of the liquor, instead of subsiding

emerges, then the word is used in a

more comprehensive, but less proper, acceptation.

As for the Causes of Precipitation the very name it self in its Chymical sense having been scarce heard of in the Peripatetic Schools, it is not to be expected, that they should have given an account of the Reasons of the thing. And 'tis like, that those sew Aristotelians, that have, by their converse with the laboratories or writings of Chymists, taken notice of this Operation, would, according to their custom on such occasions, have recourse for the explication of it to some secret sympathy or antipathy between the bodies whose

action and reaction intervenes in this

Operation.

But if this be the way proposed, of accounting for it, I shall quickly have occasion to say somewhat to it in considering the ways proposed by the Chymists, who were wont to refer Precipitation, either, as is most usual, to a sympathy betwixt the Precipitating body and the Menstruum which makes the Solvent run to the embraces of the Precipitant, and fo let fall the particles of the body sustained before; or (with others) to a great anlipathy or contrariety between the acid falt of the Menstruum and the fixed falt of the Oil, or folution of cal-

4 Of the Mechanical Causes

calcined Tartar, which is the most general and usual Precipitant they im-

ploy.

But I see not, how either of these causes will either reach to all thephe, nomena that have been exhibited or give a true account even of some of those, to which it seems applicable. For first, in Precipitations, wherein what they call a sympathy between the liquors, is supposed to produce the effect, this admired sympathy does not (in my apprehension)evince fuch a mysterious occult Quality as is presumed, but rather contists in a greater congruity as to bigness, shape, motion and pores of the minute parts between the Menstruum and the Precipitant, than between the sameSolvent and the body it kept before dissolv-And though this sympathy rightly explained may be allowed to have an interest in some such Precipitations as let fall the diffolved body in its pristine nature and form, and only reduced into minute powder; yet I find not, that in the generality

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rality of Precipitations this Doctrine will hold; For in some that we have made of Gold and Silver in proper Menstruums, after the subsiding matter had been well washed and dried, leveral Precipitates of Gold made, some with oil of Tartar, which abounds with a fixed falt, and is the usual Precipitant, and some with an Urinous Spirit, which works by Verme of a falt highly fugitive or Volatile, I found the powder to exceed the weight of the Gold and Silver I had put to dissolve 5. and the Eye it felf sufficiently discovers such Precinitates not to be meer metalline powders, but Compositions, whose confiling, not (as hath been by some body suspected) of the combined Salts alone, but of the metalline parts also, may be strongly concluded not only from the ponderousness of divers of them in reference to their bulk, but also manifestly from the reduction of true malleable metals from everal of them.

CHAP. II.

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HE other Chymical way of ex-Plicating Precipitations may, in a right sence, be made use of by a Naturalist on some particular occasi. ons. But I think it much too narrow and defective, as 'tis in a general way proposed, to be fit to be acquiesced in. For first 'tis plain, that 'tis not only Salt of Tartar and other fixed Alcalies that precipitate most bodies that are dissolved in acid Menstruums; as in making of Aurum fulminans, oil of Tartar precipitates the Gold out of Aqua Regis: But acid liquors themselves do on many occafions no less powerfully precipitate metals and other bodies out of one another. Thus spirit of Salt, (as I have often tried) precipitates Silver out of Aqua fortis: The corrofive Spirit of Nitre copioully precipitates that white powder whereof they makeBezoardicum Minerale: Spirit or oil of Chymical Precipitation. 7 oil of Sulphur made by a glass-bell precipitates Corals, Pearls, &c. dissolved in Spirit of Vinegar, as is known to many Chymists, who now use this Oleum Sulphuris per Campanam, to make the Magistery of Pearls, &c. for which vulgar Chymists imploy Oleum Tartari per deliquium.

I have sometimes made a Menstruim, wherein though there were both Acid and Alcalizate Salts; yet I did not ind, that either acid Spirits or oil of Saltar, or even Spirit of Urine would precipitate the dissolved substan-

ces.

And I have observed, both that Salts of a contrary nature will precipitate bodies out of the same Menstruum, as not only Salt of Tartar, but Seallt being dissolved, will precipitate each other, and each of them apart will precipitate Silver out of Aqua sortis; and that even, where there is a confessed contrariety betwixt two siquors, it may be so ordered, that neither of them shall precipitate what

8 Df the Mechanical Caules is dissolved by the other; of which

shall have occasion to give ere long

remarkable instance.

But it will best appear, that the abovementioned Theories of the Peripateticks and Chymists are at least insufficient to solve the Pheno. mena (many of which were probably not known to most of them, and perhaps not weigh'd by any,) if we proceed to observe the Mechanical ways, by which Precipitations may be accounted for; whereof I shall at prefent propose some Number, and say somewhat of each of them aparts not that I think all of them to be equally important and comprehenfive, or that I absolutely deny, that any one of them may be reduced to fome of the other; but that I think, it may better elucidate the subject, to treat of them feverally, when I shall have premised, that I wouldnot thence infer, that though, for the most part, Nature does principally effect Precipitations by one or other of these ways, yet in divers cases she may

may not imploy two or more of them about performing the operation.

To precipitate the Corpuscles of a metal out of a Menstruum, wherein being once throughly dissolved it would of it felf continue in that state, the two general ways that the nature of the thing feems to fuggest to him that considers it, are, either to add to the weight or bulk of the diffolved Corpufcles, and thereby render them unfit to accompany the particles of the Menstruum in their motions; or to weaken the fustaining power of the Menstruum, and thereby disable it to keep the metalline particles swimming any longer:which filling of the deferted parts of the metal or other bodie, does oftenimes the more easily insue, because in many cases, when the sustaining partides of the Menstruum come to be to much weakned, that proves an eccasion to the metalline Corpuscles, disturbed in the former motion that kept them separate, to make occurlons and coalitions among themfelves,

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selves, and their fall becomes the effect, though not equally so, of both ways of Precipitation; as on the other side, there are several occasions on which the same Precipitant, that brings the swimming particles of the metal to stick to one another, does likewise, by mortifying or disabling the saline Spirits or other parts of the solvent, weaken the sustaining power of that liquor.

CHAP. III.

Considerations about these two ways: The first of the most genera Causes of Precipitation is such a Cohæsion procured by the Precipitant in the solution, as makes the compounded corpuscles, or at least the associated particles of the dissolved body, too heavy to be sustained, or too bulky to be kept in a state of studies by the liquor.

of Chymical Pzecipitation. 11

That in many Precipitations there is made a coalition betwixt the small parts of the Precipitant and those of the dissolved metal, or other body; and frequently also with the saline spirits of the Menstruum, may be eafily shewn by the weight of the Precipitate, which though carefully washed and dryed, often surpasses; and fometimes very considerably, that of your crude metal that was disfolved; of which we lately gave an instance in Aurum fulminans and pres dpitated Silver; & we may yetgive a more conspicuous one, in that which Chymists call Luna Cornea: For, f having dissolved Silver in good Aqua fortis, you Precipitate it with the solution of Sea-salt in fair water, and from the very white Precipitate wash the loose adhering salts, the remaining powder, being dryed ad flowly melted, will look much less like a metalline body than ike a piece of horn, whence also takes its name; so considerable is the

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12 Df the Mechanical Causes the additament of the saline to the

metalline particles.

And that part offuch additaments is, retained, may not only be found by weighing, but in divers cases may be argued from what is obvious to the Eye: as if you dissolve Mercury in Aquafortis, and into the philtrated solution drop spirit of Salt, or falt-water, or an urinous spirit, as of Sal Armoniac, you will have a very white Precipitate; but if instead of any of these, you drop-in deliquated Salt of Tartar, your Precipitate will be of a brick or orange colour. From which experiment and some others I would gladly take a rife to perswade Chymists and Physicians, that 'cis not so indifferent, as those feem to think who look on Precipitation butas a kind of Comminution, by what means the precipitation is performed. For by reason of the strict adhesion of divers saline particles of the precipitant and the solvent, the precipitated body, notwithstanding all the wonted ablutions

of Chymical Pzecipitation. 13 ons, may have its qualities much diversified by those of the particles of the liquors, when these are fitted to flick very fast to it. Which last words I add, because, though that sometimes happens, yet it does not always, there being a geater difference than every body takes notice of between Precipitations; as you will be induced to think, if you precipitate the folution of Silver with Copper, with spirit of sal Armoniac, with falt water, with oil of Tartar, with quick-filver, with crude Tartar and with Zink. And in the lately proposed Example, you will think it probable, that 'tis not all one, whether to dissolved Mercury or Silver, you imploy the subtile distilled Spirits of Salt, or the gross body, whether in a dry form, or barely dissolved in common water. And thus much of the Conduciveness of weight to the striking down the Corpuscles of a dissolved Body.

That also the Bulk of a body may very much contribute to make it

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14 Df the Wechanical Caufes fink or swim in a liquor, appears by Thus Salt or obvious instances. Sugar, being put into water either in lumps or even in powder that is but gross, falls at first to the bottom, and lies there, notwithstanding the Air that may be intercepted between its parts or externally adhere to it. But when by the infinuating action of the water it is dissolved into minute particles, these are carried up and down with those of the liquor and fublide not. The like happens, when a piece of filver is cast into Aquafortis, and in many other cases.

On the other side I have several times observed, that some bodies that had long swam in a Menstruum, whilst their minute parts were kept from convening in it, did afterwards by the coalition of many of those particles into bodies of a visible bulk coagulate and subside, (though sometimes, to hinder the evaporation of the Menstruum, the vessels were kept stopt.) Of this I elsewhere mention divers examples;

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and particularly in urinous and animal spirits, well dephlegm'd, I have found, that after all had for a confiderable time continued in the form of a perfect liquor, and as to sense homogeneous, store of solid corpuscles, convening together, setled at the bottom of the glasses in the of faline Crystals. Having also long kept a very red solution of Sulphur first unlock'd, (as they speak) made with highly rectified spirit of urine, I observed, that at length the Sulphureous particles, making little concretions between themselves, totally subsided and left the liquor almost devoid of tincture. By which you may fee, that 'twas not impertinent to mention (as I lately did) among the subordinate causes of Precipitation, the affociating of the particles of a dissolved body with one another. Of which I elfewhere give a notable Example in the shining powder that I obtained from Gold dissolved in a peculiar Menstruum, without any Precipi-B 3 tant.

16 Di the Wechanical Caules

particles, to which a tract of time gave opportunity to meet and adhere in a convenient manner.

If in what the Chymists call Precipitate per se, the Mercury be indeed brought to lose its fluidity, and become a powder without being compounded with any additional body, (which doubt I elsewhere state and discourse of) it will afford us a notable instance to prove, that the coalitions of particles into clusters of the felf same matter will render them unfit for the motion requifite to fluidity. For in this odd precipitation by fire, wherein the same Menstruum is both the Liquor and the Precipitate, being not all made at once, the Corpuscles that first disclose themselves by their redness, are rejected by those of the Mercury that yet remains fluid, as unable to accompany them in the motions that belong to Mercury as such.

CHAP. IV.

DEfore I dismiss that way of Precipitating, that depends upon the unwieldiness which the Precipitant gives to the body it is to strike down, it may not be impertinent, especially in reference to the foregoing part of this Paper, to consider, that perhaps in divers cases the Corpuscles of a disfolved body may be made unfit to be my longer sustained in the Menstruum, though the Precipitant adds very little to their bulk, or at least much more to their specific weight than to it. For I have elsewere shewn, that in divers folutions made of bodys by acid Menstruums, there are either generated or extricated many small Aerial particles; and it will be eafily granted, that these may be small enough to be detained in the pores of the liquor and be invisible there, if we consider, what a multitude of aerial and formerly imperceptible bubbles

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is afforded by common water in our Pneumatical Receivers, when the incumbent air that before pressed the liquor, is pumpt out. And if the Corpufcles of the diffolved body have any little Cavities or pores fit to lodge Aerial particles, or have asperous furfaces, between whose prominent parts the generated air may conveniently lie; in such cases, I say, these Invisible bubbles may be lookt upon, as making with the folid Corpufcles they adhered to, little aggregates much lighter in Specie than the Corpuscles themselves would be; and consequently if the Precipitant confift of particles of such a size and shape as are fit to expel theselittle bubbles, and lodge themselves in the cavities possessed by them before, there will be produced new aggregates composed of the Corpuscles of the dissolved body and the particles of the Precipitant; which aggregates though they do take up very little or perhaps not at all more room (takeing that word in a popular fense) than those,

of Chymical Precipitation. 19 those, whereof the Aerial bubbles made a part, will yet be Specifically heavier than the former Aggregates were, and may thereby overcome the sustaining power of the Menstruum.

One thing more may be fit to be taken notice of before we pass on further, namely, that 'tis upon the score of the Specific gravity of a body, and not barely upon the action of the Precipitant, that an aggregate or a Convention of particles does ra-ther fall to the bottom than rife to the top. For, though the Agents that procured the Coalition, make the cluster of particles become of a bulk too unwieldy to continue in the liquor as parts of it; yet if each of them be lighter in specie than an equal bulk of the Menstruum, or if they so convene as to intercept a fufficient number of little bubbles or aerial Corpuscles between them, and so become lighter than as much of the Menstruum as they take up the room of, they will not be precipitated but

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but emerge; as may be seen in the Preparation of those Magisteries of Ve. getables, I elswhere mention; where some deeply colour'd plants being made to tinge plentifully the Lixivium they are boyled in, are afterwards by the addition of Alum made to curdle, as it were, into coloured Concretions, which being (totally or in part) too big to swim as they did before they conven'd, and too light in comparison of the Menstruum to subfide, emerge to the top and float there. An easier and neater Example to the fame purpose I remember I shewed by dissolving Camphire in highly rectified spirit of Wine, 'till the solution was very strong. For though the Camphire, when put in Lumps into the spirit, sunk to the bottom of it; yet, when good store of water, (a liquor somewhat heavier in Specie than Camphire,) was poured upon the folution, the Camphire quickly concreted and returned to its own nature, and within a while emerged to the top of the mingled liquors and floated

of Chymical Pzecipitation. 21

floated there. These particulars I was willing to mention here, that I might give an instance or two of those precipitations, that I formerly spake of as improperly so called. And here I must not decline taking notice of a Phænomenon, that sometimes occurs in Precipitations, and at first fight may seem contrary to our Doctrine about them. For now and then it bappens, that after some drops of the Precipitant have begun a Precipitation at the top or bottom of the Solvent, one shakes the vessel, that the Precipitant may be the sooner diffuled through the other liquor, but then they are quickly surprized to find, that instead of hastning the compleat Precipitation, the matter already precipitated disappears, and the folvent returns to be clear, or, as to sense, as uniform, as it was before the Precipitant was put into it. B u this Phanomenon does not at all cross our Theory. For, when this happens, though that part of the Solvent, to which the Precipitant reaches, is difabled

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disabled for Reasons mentioned in this Discourse to support the dissol. ved body, yet this quantity of the Precipitant is but small in proportion to the whole bulk of the folvent, And therefore, when the agitation of the vessel disperses the clusters of loofly concreted particles through the whole liquor, (which is seldom so exactly proportioned to the body it was to work on, as to be but just strong enough to dissolve it) that greater part of the Liquor, to which before the shaking of the vessel the Precipitant did not reach, may well be lookt upon as a fresh Menstruum, which is able to mortifie or overpower the small quantity of the Precipitant that is mingled with it, and so to destroy its late operation on the body diffolved, by which means the folution returns, as to sense, to its former Which may be illustrated by State. a not unpleasant Experiment, I remember I have long fince made by precipitating a brick-coloured powder out of a strong solution of Sublimate

of Chymical Precipitation. 23 mate made in fair water. For this subfiding matter, being laid to dry in the Philter, by which 'twas separated from the water, would retain a deep but somewhat dirty colour; and if then, putting it into the bottom of a wine glass, I poured upon it, either clear oil of Vitriol, or some other frong acid Menstruum, the Alcaliat particles being disabled and swallowed up by some of the acid ones of he Menstruum, the other acid ones would so readily dissolve the residue of the powder, that in a trice the coour of it would disappear and the whole mixture be reduced into a clear liquor, without any sediment at the bottom.

Thus much may suffice at present about the first general way of Precipitating Bodies out of the Liquors

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CHAP. V.

THE other of the two principal ways, by which Precipitations may be effected, is the difabling of the Solvent to sustain the dissolved

body.

There may be many infrances, wherein this fecond way of effecting Precipitations may be affociated by Nature with the first way formerly proposed; but not withstanding the eases, wherein Nature may (as I formerly noted) imploy both the ways therein, yet in most cases they sufficiently differ, in regard that in the former way the subsiding of the disfolved body is chiefly, if not only, caused by the additional weight as well as action of the external Precipitant; whereas in most of the instances of the later way, the effect is produced either without falt of Tartar, or any such Precipitant, or by some other quality of the Precipitant

ant more than by its weight, or at least besides the weight it adds: Though I forget not, that I lately gave an example of a shining powder of Gold, that fell to the bottom of a Menstruum without the help of an External Precipitant: But that was done so slowly, that it may be disputed, whether it were a true Precipitation; and I alledged it not as fuch, but to shew, that the increased bulk of Particles may make them unft to swim in Menstruums, wherein they swam whilst they were more minute. And the like answer may be accommodated to the Precipitate per se newly mentioned.

This premised, I proceed now to observe, that the general way, I last proposed, contains in it several subordinate wayes, that are more particular; of which I shall now mention the chief that occur to me, and though but briefly, illustrate each of them by examples. And first a Precipitation may be made, if the saline or other dissolving particles of the

Menstru-

26 Of the Wechanical Caules

Menstruum are mortified or rendred unfit for their former function, by particles of a Precipitant that are of

a contrary nature.

Thus Gold and some other minerals, being dissolved in Aqua Regis, will be precipitated with spirit of urine and other such liquors abounding with volatile and falino-fulphureous Corpuscles, upon whose account it is that they act; whence these salts themselves, though cast into a Menstruum in a dry form, will serve to make the like Precipitations. And I the rather on this occasion mention Urinous spirits than Salt of Tartar, because those volatile particles add much less of weight to the little Concretions, which compose the Precipitated powder.

Upon instances of this kind, many of the modern Chymists have built that Antipathy betwixt the Salts of the solvent and those of the Menstruum, to which they ascribe almost all Precipitations. But against this I have represented something already,

and shall partly now, and partly in the sequel of this discourse add some farther reasons of my not being satisfied with this Doctrine. For, besides that 'tis insufficient to reach many of the Phanomena of Precipitations, (as will ere long be shown,) and besides that 'tis not easie to make out, that there is any real antipathy betwixt inanimate bodies; I consider, 1. That some of those Menstruums, to which this Antipathy is attributed, do after a short commotion (whereby they are disposed to make convenient occursions and coalitions) amicably unite into concretions participating of both the Ingredients; as I have somewhere shewn by an Example purposely devis'd to make this out; to do which I dropped a clear folution of fixed Nitre, instead of the usual one of common falt, upon a solution of filver, in Aqua-fortis: For the saline particles of the Solvent and those of the Precipitant, will, as I have elsewhere recited.

28 Of the Wechanical Causes recited, for the most part friendly unite into such Crystals of Nitre for the main, as they were obtained from: And though this notion of the Chymists, if well explained, be applicable to far more instances than the proposers of it seemed to have thoughton, and may be madegood use of in Practice; yet I take it to be such as is not true Universally, and , where it is true, ought to be explicated according to Mechanical Principles. For, if the particles of the Menstruum and those of the Precipitant be so framed, that upon the action of the one upon the other, there will be produced Corpuscles too big and unwieldy to continue in the state of fludity, there will insue a Precipitation: But if the constitution of the corpuscles of the Precipitating and of the Dissolved body be such, that the Precipitant also it self is fit to be a Menstruum to dissolve that body in; then, though there be an union of the Salts of the Precipitant

of Chymical Precipitation. 29 tant and the metal (or other solutum) and perhaps of the solvent too. yet a Precipitation will not necessarily follow, though the faline particles of the two liquors seemed, by the heat and ebullition excited between them upon their meeting, to exercise a great and mutual antipathy. To satisfie some Ingenious men about this particular, I dissolved Zink or Speltar in a certain urinous spirit; (for, there are more than one that may serve the turn;) and then put to it a convenient quantity of a proper acid spirit; but though there would be a manifest conflict thereby occasioned betwixt the two liquors; yet the speltar remained dissolved in the mixture. And I remember, that for the same purpose I devised another Experiment, which is somewhat more easie and more clear. I dissolved Copper calcined perse, or even crude, in strong spirit of salt; (for unless it be such, it will not be so proper,) and having put to it by degrees a

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30 Of the Wechanical Caules good quantity of spirit of Sal-Armoniac or fermented Urine, though there would be a great commotion with hissing and bubbles produced, the Copper would not be precipitated, because this Urinous spirit will as well as the Salt, (and much more readily) dissolve the same metal, and it would be kept dissolved notwithstanding their operation on one another; the intervening of which, and their action upon the metalline corpuscles, may be gathered from hence, that the green solution, made with spirit of salt alone, will by the super-vening urinous spirits be changed either into a blewish green, or, if the proportion of this spirit be very great, into a rich blew almost like ultramarine. And from these two Experiments we may probably argue, that when the Precipitation of a metal &c. insues, it is not barely on the account of the supposed Antipathy betwixt the Salts, but because the causes of that seeming Antipathy

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of Chymical Precipitation. 31 do likewise upon a Mechanical account dispose the Corpuscles of the confounded liquors so to cohere, as to be too unwieldy for the fluid part.

CHAP. VI.

A Nother way, whereby the diffolving particles of a Menstruum may be rendred unfit to sustain the dissolved body, is to present them another that they can more easily work on.

A notable Experiment of this you have in the common practice of Refiners, who, to recover the Silver out of Lace and other such mixtures wherein it abounds, use to dissolve it in Aqua fortis, and then in the solution leave Copper plates for a whole night (or many hours.) But if you have a mind to see the Experiment without waiting so long, you may imploy

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imploy the way, whereby I have often quickly dispatched it. As soon then as I have dissolved a convenient quantity, which needs not be a great one, of Silver in cleanfed Aquafortis, I add twenty or twenty five times as much of either distilled water or rain water; (for though common water will sometimes do well, yet it seldome does so well;) and then into the clear folution I hang by a string a clean piece of Copper, which will be presently covered with little shining plates almost like scales of fish, which one may easily shake off and make room for more. And this may illustrate what we formerly mentioned about the subsiding of metalline corpuscles, when they convene in liquors, wherein, whilst they were dispersed in very minute parts, they swam freely. For in this operation the little scales of Silver seemed to be purely metalline, and there is no laline Precipitant, as Salt of Tartar or of Urine, imployed to make them subside.

of Chymical Precipitation. 33 subside. Upon the same ground, Gold and Silver dissolved in their proper Menstruums may be precipitated with running Mercury; and if a Solution of blew Vitriol (such as the Roman, East Indian, or other of the like colours) be made in water, a clean plate of Steel or Iron being immersed in it, will presently be overlaid with a very thin case of Copperwhich after a while will grow thick, er; but does not adhere to the iron foloosely as to be shaken off, as the Precipitated filver newly mentioned may be from the Copper-plates whereto it adheres. And that in these operations the saline particles may really quit the diffolved body, and work! upon the Precipitant, may appear by the lately mentioned practice of Refiners, where the Aquafortis, that forsakes the particles of the filver, falls a working upon the copper-plates imployed about the Precipitation, and dissolves so much of them as to acquire the greenish C 4 blew

blew colour of a good folution of that metal. And the Copper we can easily again without salts obtain by Precipitation out of that liquor with iron, and that too, remaining dissolved in its place, we can precipitate with the tastless powder of another Mineral.

Besides these two ways of weakning the Menstruum, namely, by mortifying its saline particles or seducing them to work on other bodies, and to forsake those they sirst dissolved, there are some other ways

of weakning the Menstruum.

A Third way of effecting this, is by lessening or disturbing the agitation of the solvent. And indeed since we find by experience, that some liquors when they are heated, will either dissolve some bodies they would not dissolve at all when they were cold, or dissolve them more powerfully or copiously when hot than cold; 'tis not unreasonable to suppose, that what considerably lessense.

of Chymical Pzecipitation. 35 fens that agitation of the parts of the Menstruum that is necessary to the keeping the dissolved body in the state of fluidity, should occasion the falling of it again to the bottom. flow operations I could give divers examples of the precipitating power of Cold; there being divers solutions and particularly that of Ambergreece, that I had kept fluid all the Summer, which in the Winter would And the like may be sometimes observed in far less time in the folutions of Brimstone made in certain oleaginous Menstruums; and I have now & then had some solutions, and particularly one of Benzoin made in spirit of wine, that would surprize me with the turbidness (which begins the state of Precipitation) it would acquire upon a sudden change of the weather towards Cold, though it were not in the winter season.

Another way of weakening the Menstruum and so causing the Precipitation of a body dissolved in it, is the

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the diluting or lessening the tenacity of it, whether that tenacity proceed from viscosity or the competent number and constipation of the

parts.

Of this we have an instance in the Magisteries (as many Chymists are pleased to call them) of Jalap, Benzoin, and of divers others, Resinous and Gummous bodies dissolved in spirit of wine. For by the affusion of common water, the Menstruum being too much diluted is notable to keep those particles in the state of fluidity, but must suffer them to subfide, (as they usually do in the form of white powder,) or, (as it may happen sometimes,) make some parts emerge. Examples also of this kind are afforded us by the common preparations of Mercurius Vita. though in oil of Antimony, made by the Rectification of the butter, the faline particles are so numerous and keep so close to one another, that they are able to sustain the Antimonial

nial Corpuscles they carried over with them in Distillation, and keep them together with themselves in the form of a liquor; yet when by the copious affusion of the water, those sustaining particles are separated and removed to a distance from each other, the Antimonial Corpuscles and the Mercurial (if any such there were,) being of a ponderous nature, will easily subside into that Emetic powder, which, (when well washed) the Chymists slatteringly enough call Mercurius Vite.

But here I must interpose an advertisement, which will help to shew us, how much Precipitations depend upon the Mechanical contextures of bodies. For, though not only in the newly recited examples, but in divers others, the affusion of water, by diluting the salts and weakenning the Menstruum, makes the metall or other dissolved body fall precipitately to the bottom; yet if the saline particles of the solvent, and those

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those of the body be fitted for so strict an union, that the Corpuscles resulting from their Coalitions will not so easily be separated by the particles of water, as fuffer themselves to be carried up and down with them, whether because of the minuteness of these compounded Corpuscles, or because of some congruity betwixt them and those of the water; they will not be precipitated out of the weakened folution, but still continue a part of it; as I have tryed partly with some solution of Silver and Gold, made in acid Menstruums, but much more satisfactorily in solutions of Copper, madein the urinous spirit of Sal Armoniac. For, though that blew folution were diluted with many thousand times as much distilled water as the dissolved metal weighed; yet its swimming Corpuscles did by their colour manifestly appear to be dispersed through the whole liquor.

CHAP.

CHAP. VII.

BUT, to profecute our former discourse, which we broke off after the mention of Mercurius Vite, twill now be seasonable to add, that we have made divers other Precipitations, by the bare affusion of water, out of solutions, and sometimes out of distilled liquors; which, for brevity sake, I here omit, that I may aften to the last way I shall now say to mention.

Another way then, whereby Precipitations of bodies may be produced by debilitating the Menstruum they swim in, is by lessening the proportion of the Solvent to the Solvent, without any evaporation of the liquor. These last words I add, because that, when there is an obstruction or any other expulsion of the Menstruum by heat, if

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41 Of the Berhanical Caules

it be total, 'tis called Exficcation, as when dry falt of Tartar is obtained from the filtrated Lixivium of the calcined Tartar; and though the evaporation be not total, yet the effects of it are not wont to be reckoned amongst Precipitati-And although the way, I am about to propose, if it be attentively confidered, has much affinity with the foregoing, and the Phanomena may perhaps in some fort be reduced to them; yet the instances that I shall name, having not, that I know, been thought of by others, and being fuch as every one would not deduce from what I have been mentioning, I shall add a word of the inducements I had to make the tryals, as well as of the success of them.

Considering then, that Water will not dissolve Salts indefinitely, but when it has received its due proportion, 'twill then dissolve no more, but, if they be put into it, let them

of Chymical Pzecipitation. 40 fall to the ground and continue undiffolved; and that if when water is fatiated, any of the liquor be evaporated or otherwise walted, it will in proportion let fall the falt it had already taken up; I concluded, that if I could mingle with water any liquor, with which its particles would more readily affociate than with those of Salt, the depriving the folution of fo many of its aqueous particles would be equivalent to the evaporation of as much water or thereabouts, as they, by being united, could compose. Wherefore making a lixivium of distilled water or clean rain-water, and of Salt of Tartar fostrong, that if a grain more were cast in it, it would lie undiffolved at the bottom; I put a quantity of this fiery Lixivium into a slender cylindrical vessel, till it had therein reached fuch a height as I thought fit; then

taking as much as I thought sufficient of strong spirit of wine, that

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42 Of the Bechanical Causes

would burn every drop away, that so it might have no flegm nor water of its own, I poured this upon the saline solution, and shaking the liquors pretty well together to bring them to mix as well as I could, I laid the tube in a quiet place, and afterwards found, as I expected, that there was a pretty quantity of white falt of Tartar fallen to the bottom of the veffel, which falt had been meerly forsaken by the aque. ous particles that sustained it before, but forfook it to pass into the spirit of wine, wherewith they were more disposed to affociate themselves; which I concluded, because having, before I poured on this last named liquor, made a mark on the glass to shew how far the lixivium reached, I found (what I looked for) that after the Precipitation, the Lixivium, that remained yet strong enough to continue unmixed with the incumbent spirit, had its surface not where the mark shewed it had been

of Thymical Precipitation. 43

been before, but a considerable distance beneath it, the spirit of wine having gained in extent what it loft in strength by receiving so many aqueous particles into it. I chose to make this tryal rather with a Lixivium of Salt of Tartar than with oyl of Tartar per Deliquium, because in this last named liquor the aqueous and saline particles are more closely combined and therefore more difficult to be separated han I thought they would be in a lixivium haltily made, though very frong. And though by much agitation I have sometimes obtained ome falt of Tartar from the abovementioned oil; yet the experiment succeeded nothing near so well with that liquor as with a Lixivium.

I made also the like tryal with exceedingly dephlegmed spirit of wine, and as strong a Brine as I could make of common salt dissolved without heat in common water; and I thereby obtained no despicable proportion of finely figured salt, that

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was let fall to the bottom. But this experiment, to be successful, requires greater care in him that makes it,

than the former needs.

To confirm, and somewhat to vary this way of Precipitation, I shall add, that having made a clear Solution of choice Gum Arabic in common water, and poured upon it a little high rectified spirit of wine, on this occasion there was also made, and that in a trice, a copious precipitation of a light and purely white substance not unpleasant to behold. And for further Confirmation I dissolved a full proportion of Myrrhe in fair water, and into the filtrated solution, which was transparent, but of a high brown colour, I dropt a large proportion (which Circumstance is not to be omitted) of carefully dephlegm'd spirit of wine, which according to expectation made a copious Precipitate of the Gum. And these instances ! the rather set down in this place, because they seem to show, that **fimple**

of Chymical Precipitation. 45 simple water is a real Menstruum, which may have its dissolving and sustaining virtue weakened by the accession of Liquors, that are not doubted to be much stronger than it.

By specifying the hitherto mentioned wayes, whereby Precipitations may be Mechanically performed and accounted for, I would by no means be thought to deny, that there may be some omitted here, which either others that shall consider the matter with more attention, or I my self, if I shall have leisure to do it, may think on. For I propose these but as the chiefthat occurr to my present thoughts; and I forbear to add more instances to exemplifie them, because I would not injure some of my other papers, that have a greater right to those Instances. Only this I shall note in general, that the Doctrine and History of Precipitations, if well delivered, will be a thing of more extent and moment than feems hitherto to have been imagined; fince not only feveral of D 2 the

46 Df the Wechanical Caufes &c.

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the changes in the blood and other liquors and juices of the humane body may thereby be the better understood; and they prevented, or their ill consequences remedied; but in the practical part of Mineralogy divers usefull things may probably be performed by the affiftance of such a Doctrine and Histo-To keep which conjecture ry. from feeming extravagant, I shall only here intimate, that 'tis not alone in bodies that are naturally or permanently liquid, but in those folid and ponderous bodies, that are for a short time made so by the violence of the fire, that many of the things suggested by this Doarine may have place. For whilft divers of those Bodies are in fusion, they may be treated as liquors; and metalls, and perhaps other heterogeneous bodies may be obtained from them by fit though dry Precipitants, as in some other writings I partly did, and may elsewhere yet further, declare.

FINIS.

Experiments and Potes ABOUTTHE MECHANICAL PRODUCTION

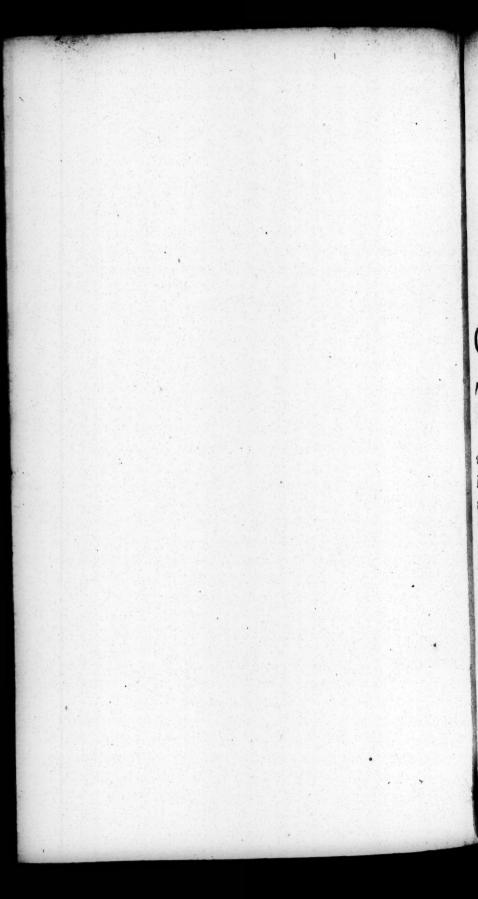
Magnetism.

By the Honourable

ROBERT BOYLE Esq. Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.



ADVER TISEMENT

Concerning the following

NOTES

About OCCULT

QUALITIES.

THE following Papers (about Magnetism and Electricity) would appear with less disadvantage, if the Author's willingness and Promise, that this Tome should be furnished with notes about some Occult Qualities as well as about divers forts of those that are presumed to be Manifest, did not prevail with him to let the ensuing Notes appear without those about the Pores of Bodies and Figures of Corpuscles, that should have preceded them, and some others that should have

accom-

Advertisement.

accompanied them. But the Author chose rather to venture these Papers abroad in the Condition. Such as 'tic, they now appear in, than make those already printed about manifest Qualities stay longer for Accessions, which some troublesome Accidents will not suffer him to hasten to the press; and without which, he now fears this Tome may swell to a more than competent Bulk.

Experiments and Notes

ABOUT THE

Mechanical Production

OF

MAGNETICAL QUALITIES.

Loadstone be none of the least famous of Occult Qualities, and are perhaps the most justly admired; yet I shall venture to offer something to make it probable, that some, even of these, may be introduced into bodies by the production of Mechanical changes in them.

To make way for what I am to deliver to this purpose, it will be ex-

2 Df the Dethanital Production pedient to remove that general and fettled prejudice, that has kept men from so much as thinking of any Mechanical account of Magnetisms, which is a belief, that these Qualities do immediately flow from the substantial Form of the Loadstone, whose abstructe nature is disproportionate to our understandings. But for my part, I con-

EXPER. I. fels, liee no necessity of admitting this sup-

polition; for I fee, that a piece of Steel fiely shaped and well excited, will, like a Loadstone, have its determinate Poles, and with them point at the North and South; it will draw other pieces of Iron and Steel to it, and which is more, communicate to them the same kind, though not degree, of attractive and dire-Give vertue it had it felf, and will possels these faculties not as light and transient impressions, but as such fetled and durable Powers that it may retain them for many years, if the Loadstone to which it has been duly

duly applied, were vigorous enough: Of which fort I remember I have feen one (and made some tryals with it) that yielded an income to the owner, who received money from Navigators and others for suffering them to touch their needles, swords, knives &c. at his excellent Magnet. Now, in a piece of steel or iron thus excited, itis plain, that the Magnetic operations may be regularly performed for whole years by a body, to which the form of a Loadstone does not belong, since, as it had its own form before, so it retains the same still, continuing as malleable, fulible &c. as an ordinary piece of the same metal unexcited: so that, if there be introduced a fit disposition into the internal parts of the metal by the action of the Loadstone, the metal, continuing of the same Species it was before, will need nothing fave the continuance of that acquired disposition to be capable of performing Magnetical Operations; and if this disposition or inter-A 4

a of the Dethanical Deduction

nal constitution of the excited iron

be destroyed, though the form of

the metal be not at all injured, yet

the former power of Attraction

shall be abolished,

EXPER. II. as appears when an

excited iron is made

red hot in the fire, and suffered to

cool again,

And here give me leave to take notice of what I have elsewhere related to another purpose, namely that a Loadstone EXPER. III. may (as I have more than once tryed) be easily deprived by ignition of its Power of sensibly attracting Martial bodies, and yetbe scarce, if at all, visibly changed, but continue a true Loadstone in other capacities, which, according to the vulgar Philosophy ought to depend upon its Substantial Form, and the Loadstone thus spoiled may, notwithstanding this Form, have its Poles altered at pleasure like a piece

piece of Iron; as I have else-

where particularly declared.

And I will confirm what I have been saying with an experiment that you do not perhaps expect; namely, that though it be generally taken for granted (without being contradicted that I know of by any man) that, in a found Loadstone, that has never been injured by the fire, not only the attractive Power, but the particular Vertue that it has to point constantly, when left to it felf, with one of its determinate extreams to one determinate pole, flowes immediately from the substantial or at least essential Form; yet this Form remaining undestroyed by Fire, the Poles may be changed, and that with ease and speed. For among my notes about Magnetical Experiments, whence I borrow some passages of this paper, I find the following Account.

EXPER. IV.

Loadstone hath by this determinate Pole or Extream to attract, for example, the South-end of a poi-sed needle, and with the opposite extream or Pole the North-end of the same needle, I made among other tryals the following Experiment.

Taking a very small fragment of a Loadstone, I found, agreeably to my conjecture, that by applying fometimes one Pole, sometimes the other, to that pole of (a small but) a very vigorous Loadstone that was fit for my purpose, I could at pleafure, in a few minutes, change the Poles of the little fragment, as I tryed by its operations upon a needle freely poised; though by applying a fragment a pretty deal bigger, (for in it felf it appeared very small,) I was not able in far more hours than I employed minutes before, to make any sensible change of the Poles.

This

This short Memorial being added to the preceding part of this difcourse, will, I hope, satisfie you, that how unanimoully fo ever men have deduced all magnetick operations from the form of the Loadstone; yet some internal change of pores or some other Mechanical alterations or inward disposition, either of the excited Iron or of the Loadstone it self, may suffice to make a body capable or uncapable of exercifing some determinate magnetical operations; which may invite you to cast a more unprejudiced eye upon those few particulars, I shall now subjoin to make it probable, that even Magnetical Qualities may be Mechanically produced or altered.

EXPER. V.

I Have often observed in the shops of Artificers, as Smiths, Turners of metals &c. that, when hardened and well tempered tools are well heated by Attrition, if whilest

8 Of the Wechanical Production whilest they are thus warmed you apply them to filings or chips, as they call them, or thin fragments of Steel or Iron, they will take them up, as if the instruments were touched with a Loadstone: but as they will not do so, unless they be thus excited by rubbing till they be warmed, by which means a greater commotion is made in the inner parts of he Steel so neither would they retain so vigorous a Magnetism as to support the little fragments of Steel that stuck to them after they were grown cold again. Which may be confirmed by what, if I much mifremember not, I shewed some Acquaintances yours; which was, that, by barely rubbing a conveniently shaped piece EXPER. VI. of Steel against the

of Steel against the floor till it had gained a sufficient heat, it would whilest it continued so, discover a manifest, though but faint attractive power, which vanished together with the adventitious Heat,

EXPER. VII.

TTE elsewhere observe, which perhaps you also may have done, that the Iron bars of windows, by having stood very long in an erected posture, may at length grow Magnetical, so that, if you apply the North point of a poised and excited Needle to the bottom of the Bar, it will drive it away, & attract the Southern; and if you raise the magnetick needle to the upper part of the Bar, and apply it as before, this will draw the Northern extream. which the other end of the bar expelled; probably because, as 'tis elsewhere declared, the bar is in tract of time, by the continual action of the Magnetical effluvia of the Tarraqueous Globe, turned into a kind of Magnet, whose lower end becomes the North-pole of it, and the other the Southern. Therefore according to the Magnetical Laws, the former must expel the Northern extream

10 Df the Bechanical Production tream of the Needle, and the later drawit.

EXPER. VIII.

Have found indeed, and I queftion not but other observers may have done so too, that, if a bar of Iron, that has not stood long in an erected posture, be but held perpendicular, the forementioned experiment will succeed, (probably upon fuch an account as that I have lately intimated:) But then this virtue, displayed by the extreams of the bar of Iron, will not be at all permanent, but so transient, that, if the bar be but inverted and held again upright, that end which just before was the uppermost, and drew the north-end of the needle, will now, being lowermost, drive it away, which, as was lately observed, will not happen to a bar which has been fome years or other competent time kept in the same Position. So that, fince

fince length of time is requisite to make the verticity of a bar of Iron so durable & constant, that the same extream will have the same virtues in reference to the Magnetical needle, whether you make it the upper end or the lower end of the bar, it seems not improbable to me, that by length of time the whole Magnetick virtue of this Iron may be increased, and consequently some degree of at-

traction acquired.

And by this Consideration I shall endeavour to explicate that strange thing that is reported by some Moderns to have happened in Italy, where a bar of Iron is affirmed to have been converted into a Loadstone, whereof a piece was kept among other rarities in the curious Aldrovandus his Musaum Metallicum. For confidering the greatness of its Specific Gravity, the malleableness and other properties, wherein Iron differs from Loadstone, I cannot easily believe, that, by fuch a way as is mentioned, a metal should be turned into

12 Of the Bechanical Production into a stone. And therefore, having consulted the book it self, whence this Relation was borrowed, I found the story imperfectly enough delivered: The chiefest and clearest thing in it being, that at the top of the Church of Arimini a great iron-bar, that was placed there to support a Cross of an hundred pound weight, was at length turned into a Loadstone. But whether the reality of this transmutation was examined. and how it appeared that the fragment of the Loadstone presented to Aldrovandus was taken from that bar of Iron, I am not fully satisfied by that Narrative. Therefore, when I remember the great resemblance I have fometimes seen in colour, besides other manifest Qualities, betwixt fome Loadstones and some course or almost rusty Iron, I am tempted to Conjecture, that those that observed this Iron-bar when broken to have acquired a strong Magnetical virtue, which they

dreamed not that tract of time might

com-

communicate to it, might easily be perswaded, by this virtue and the resemblance of colour, that the Iron was turned into Loadstone: especially they being preposses d with that Aristotelian Maxim, whence our Author would explain this strange Phanomenon, that inter symbolum had best in familie of the resemblant in

bentia facilis est transmutatio.

But, leaving this as a bare conjedure, we may take notice, that what virtue an oblong piece of Iron may need a long tract of time to acquire, by the help onely of its position, may be imparted to it in a very short time, by the intervention of such a nimble agent, as the fire. As may be often, though not always,

observed in Tongs, EXPER. IX.

and fuch like Iron

Utenfils, that, having been ignited, have been fet to cool, leaning against some wall or other prop, that kept them in an erected posture, which makes it probable that the great commotion of the parts, made by the vehement heat of the sire, disposed

the Iron, whilst it was yet soft, and had its pores more lax, and parts more pliable, disposed it, I say, to receive much quicker impressions from the Magnetical effluvia of the Earth, than it would have done, if it had still been cold.

E X P E R. X. And 'tis very obfervable to our

present purpose, what differing effects are produced by the operation of the fire, upon two Magnetick bodies according to their respective constitutions. For, by keeping a Loadstone red-hot, though you cool it afterwards in a perpendicular posture, you may deprive it of its former power of manifestly attracting: But a bar of Iron being ignited, and set to cool perpendicularly, does thereby acquire a manifest verticity. Of which differing events I must not now stay to inquire, whether or no

now stay to inquire, whether or no the true reason be, That the peculiar Texture or internal constitution that makes a Loadstone somewhat more than an ordinary Ore of Iron, (which metal,

metal, as far as I have tried, is the usual ingredient of Loadstones) being spoiled by the violence of the fire. this rude Agent leaves it in the condition of common Iron, or perhaps of ignited Iron-ore: whereas the fire does soften the Iron it self (which is a metal not an Ore) agitating its parts, and making them the more flexible, and by relaxing its pores, disposes it to be easily and plentifully pervaded by the Magnetical steams of the Earth, from which it may not improbably be thought to receive the verticity it acquires; and this the rather, because, as I have often tryed, and

elsewhere mention-EXPER. XI.

ed, if an oblong

Loadstone, once spoil'd by the fire, be thorowly ignited and cooled either perpendicularly, or lying horizontally North and South, it will, as well as a piece of Iron handled after the same manner, be made to acquire new poles, or change the old ones, as the skilful experimenter pleases.

B 2 But But whatever be the true cause of the disparity of the fires operation upon a sound Loadstone and a bar of Iron, the effect seems to strengthen our conjecture, That Magnetical operations may much depend upon Mechanical Principles. And I hope you will find further probability added to it, by some Phænomena recited in another paper, to which I once committed some promiscuous Experiments and Observations Magnetical.

EXPER. XII.

IF I may be allowed to borrow an Experiment from a little Tract *

* Relating to the that yet lyes by me, Magnetism of the and has been seen but by two or three friends, it may be added to the instances already given about the production of Magnetism. For in that Experiment I have shewn, how having brought a good piece of a certain kind of English Oker, which yet perhaps was no fitter

fitter than other, to a convenient shape, though, till it was altered by the fire, it discovered no Magnetical Quality; yet after it had been kept red-hot in the fire and was suffered to cool in a convenient posture, it was enabled to exercise Magnetical operations upon a pois'd Needle.

EXPER. XIII.

A S for the Abolition of the Magneti-1 cal vertue in a body endow'd with it, it may be made without deftroying the Substantial or the Essential Form of the body, and without fenfibly adding, diminishing, or altering any thing in reference to the Salt, Sulphur and Mercury, which Chymists presume Iron and Steel, as well as other mixt bodies, to be composed of. For it has been sometimes observed, that the bare continuance of a Loadstone it felf in a contrary position to that, which, when freely placed, it feems to effect, has either corrupted or sensibly lessened the vertue of it. What I formerly observed to this purpose, I elsewhere relate, and fince that having a Loadstone, whose vigor was look'd upon by skilful persons as very extraordinary, and which, whilst it was in an Artificers hand, was therefore held at a high rate, I was careful, being

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by fome occasions call'd out of London, to lock it up, with fome other rarities, in a Cabinet, whereof I took the key along with me, and still kept it in my own Pocket. But my tlay abroad proving much longer than I expected, when, being returned to London, I had occasion to make use of this Loadstone for an Experiment, I found it indeed where I left it, but fo exceedingly decayed, as to its attractive power, which I had formerly examin'd by weight, by having lain a most a year in an inconvenient posture, that if it had not been for the circumstances newly related. I should have concluded that some body had purposely got it out in my absence, and spoiled it by help of the fire, the vertue being so much impaired, that I cared little to employ it any more about confi-

derable Experiments. EXPER. XIV. And this corruption of

the Magnetical vertue, which may in tract of time be made in a Loadstone it self, may in a trice be made by the help of that Stone in an excited Needle. For 'tis observ'd by Magnetical Writers, and my own Trials purposely made have affured me of it, that a well pois'd Needle, being by the touch of a good Loadstone, excited and brought to turn one of its ends to the North and the

other to the South, it may by a contrary touch of the same Loadstone be deprived of the faculty it had of directing its determinate extreams to determinate Poles. Nay, by another touch (or the same, and even without immediate Contact, if the Magnet be vigorous enough) the Needle may presently have its direction so changed, that the end, which formerly pointed to the North pole, shall now regard the South, and the other end shall instead of the Southern, respect the Northen pole.

EXPER. XV.

ND to make it the more probable, that the change of the Magnetism communicated to Iron may be produc'd at least in good part by Mechanical operations, procuring some change of texture in the Iron; I shall subjoyn a notable Experiment of the ingenious Doctor Power. which when I heard of, I tryed as well as I could; and though, perhaps for want of conveniency, I could not make it fully anfwer what it promised, yet the success of the trial was confiderable enough to make it pertinent in this place, and to induce me to think, it might yet better succeed with him, whose Experiment, as far as it concerns my present purpose, imports, that

of Iron, be, by being ignited and suffered to cool North and South, and hammered at the ends, very manifestly endow'd with Magnetical vertue, this vertue will in a trice be destroyed, by two or three smart blows of a strong hammer upon the middle

of the oblong piece of Iron.

But Magnetism is so fertile a Subject, that if I had now the leisure and conveniency to range among Magnetical Writers, I should scarce doubt of finding, among their many Experiments and Observations, divers that might be added to those above delivered, as being easily applicable to my present Argument. And I hope you will find farther probability added to what has been said, to shew, that Magnetical operations may much depend upon Mechanical Principles, by some Phanomena recited in another Paper, to which I once committed some promiscuous Experiments and Observations Magnetical.

Experiments and Notes

MECHANICAL ORIGINE

OR

PRODUCTION

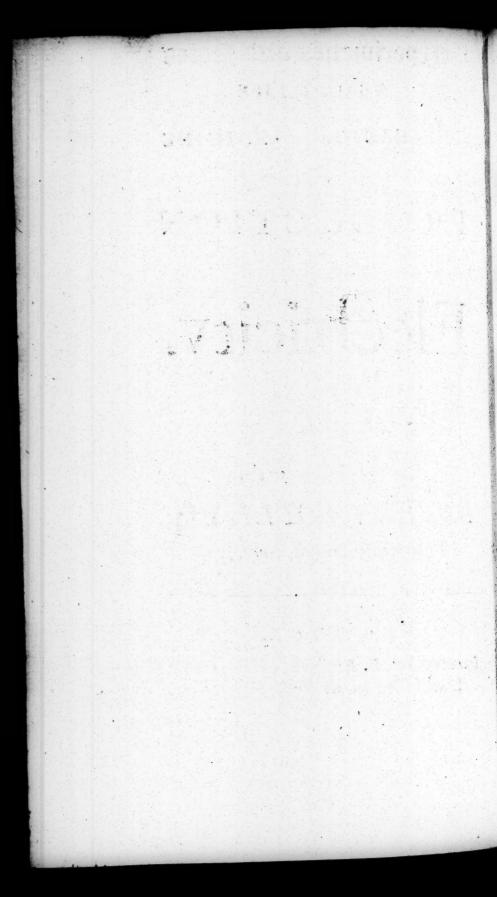
OF

Electricity.

By the Honourable ROBERT BOYLE Efq; Fellow of the R. Society.

LONDON:

Sold by Sam. Smith, at the Prince's Arms in St. Paul's Church-Yard. 1690.



Experiments and Notes

ABOUT THE

MECHANICAL ORIGINE

OR

PRODUCTION

OF

Electricity.

Hat 'tis not necessary to believe Electrical Attraction
(which you know is generally listed among Occult Qualities)
to be the effect of a naked and solitary Quality flowing immediately
from a Substantial Form; but that it
may rather be the effect of a Material Effluvium, issuing from, and returning to, the Electrical Body (and
A 2 per-

perhaps in some cases assisted in its Operation by the external air) seems agreable to divers things that may be observed in such Bodies and their

manner of acting.

There are differing Hypotheses (and all of them Mechanical, propos'd by the Moderns) to solve the Phænomena of Electrical Attraction. Of these Opinions the First is that of the learned Jesuite Cabeus, who, though a Periparetick and Commentator on Aristotle, thinks the drawing of light Bodies by Jet, Amber, &c. may be accounted for by suppofing, that the steams that issue, or, if I may so speak, fally, out of Amber, when heated by rubbing, discuss and expell the neighbouring air; which after it has deen driven off a little way, makes as it were a small whirlwind, because of the resistance it finds from the remoter air, which has not been wrought on by the Electrical Steams; and that shrinking back swiftly enough to the Amber, do in their returns bring along

long with them such light bodies as they meet with in their way. On occasion of which Hypothesis I shall offer it to be considered, Whether by the gravity of the Atmospherical Air, surmounting the Specifick Gravity of the little and rarisid Atmosphere, made about the Amber by its emissions, and comprising the light Body fastened on by them, the Attraction may not in divers cases be

either caused or promoted.

Another Hypothesis is that proposed by that Ingenious Gentleman Sir Kenelm Digby, and embraced by the very Learned Dr. Browne, (who seems to make our Gilbert himself to have been of it) and divers other sagacious men. And according to this Hypothesis, the Amber, or other Electrick, being chased or heated, is made to emit certain Rayes or Files of unctuous Steams, which, when they come to be a little cool'd by the external air, are somewhat condens'd, and having lost of their former agitation, shrink back to the A 2 body

4 Of the Wechanical Dzigine

body whence they sallied out, and carry with them those light bodies, that their further ends happen to adhere to, at the time of their Retraction: As when a drop of Oyl or Syrup hangs from the end of a small stick, if that be dextrously and cautiously struck, the viscous substance will, by that impulse, be stretch'd out, and presently retreating, will bring along with it the dust or other light bodies that chanced to stick to the remoter parts of it.

And this way of explaining Electrical Attractions is employ'd also by the Learned Gassendus, who addes to it, that these Electrical Rays (if they may be so call'd) being emitted several ways, and consequently crossing one another, get into the pores of the Straw, or other light body to be attracted, and by means of their Decussation take the saster hold of it, and have the greater force to carry it along with them, when they shrink back to the Amber

ber whence they were emitted.

A third Hypothesis there is, which was devised by the Acute Cartefins, who dislikes the Explications of others, chiefly because he thinks them not applicable to Glass, which he suppoles unfit to send forth Effluvia, and which is yet an Electrical body; and therefore attempts to account for Electrical Attractions by the intervention of certain particles, shap'd almost like small pieces of Ribbond, which he supposes to be form'd of this subtile matter harbour'd in the pores or crevises of Glass. But this Hypothesis, though ingenious in it self, yet depending upon the knowledge of divers of his peculiar Principles, I cannot intelligibly propose it in sew words, and therefore shall refer you to himself for Princip, part 4. an account of it: which

I the less scruple to do, because though it be not unworthy of the wonted Acuteness of the Authour, yet he seems himself to doubt, whe-

A 4 ther

ther it will reach all Electrical Bodies; and it feems to me, that the reason why he rejects the way of explicating Attraction by the Emifsion of the finer parts of the attrahent (to which Hypothesis, if it be rightly proposed, I confess my self very inclinable) is grounded upon a mistake, which, though a Philosopher may, for want of Experience in that Particular, without disparagement fall into, is nevertheless a mistake. For whereas our excellent Author says, that Electrical Effluvia, such as are supposed to be emuted by Amber, Wax, &c. cannot be imagin'd to proceed from Glass, I grant the Supposition to be plaufible, but cannot allow it to be true. For as solid a body as Glass is, yet if you but dextrously rub for two or three minutes a couple of pieces of Glass against one another, you will find that Glass is not onely capable of emitting Effluvia, but such ones as to be odorous, and sometimes to be rankly stinking. But

But it is not necessary, that in this Paper, where I pretend not to write Discourses but Notes, I should confider all that has been, or I think may be, said for and against each of the above-mentioned Hypotheses; fince they all agree in what is sufficient for my present purpose, namely, that Electrical Attractions are not the Effects of a meer Quality, but of a Substantial Emanation from the attracting Body: And 'tis plain, that they all endeavour to folve the Phanomena in a Mechanical way, without recurring to Substantial Forms, and inexplicable Qualities, or fo much as taking notice of the Hypostatical Principles of the Chy-Wherefore it may suffice in this place, that I mention some Phanomena that in general make it probable, that Amber, &c. draws such light Bodies, as pieces of Straw, Hair, and the like, by vertue of some Mechanical Affections either of the attracting or of the attracted Bodies, or of both the one and the other.

I. The

1. The first and most general Observation is, That Electrical Bodies draw not unless they be warm'd; which Rule though I have now and then found to admit of an Exception, (whereof I elsewhere offer an account,) yet, as to the generality of common Electricks, it holds well enough to give much countenance to our Doctrine, which teaches the effects of Electrical Bodies to be perform'd by Corporeal Emanations. For 'tis known, that Heat, by agitating the parts of a fit Body, solicites it as it were to fend forth its Effluvia, as is obvious in odoriferous Gums and Perfumes, which, being heated, fend forth their fragrant steams, both further and more copiously than otherwise they would.

2. Next, it has been observed, that Amber, &c. warm'd by the fire, does not attract so vigorously, as if it acquire an equal degree of heat by being chast'd or rub'd: So that the modification of motion in the internal parts, and in the Emanations of

the

the Amber, may, as well as the degree of it, contribute to the Attraction. And my particular Observations incline me to adde, that the effect may oftentimes be much promoted, by employing both these ways successively; as I thought I manifestly found when I first warm'd the Amber at the fire, and presently after chaf'd it a little upon a piece of cloth. For then a very few rubbings feem'd to excite it more than many more would otherwise have done: As if the heat of the fire had put the parts into a general, but confus'd, agitation; to which 'twas easie for the subsequent Attrition (or Reciprocation of Pressure) to give a convenient modification in a Body whose Texture disposes it to become vigoroufly Electrical.

3. Another Observation that is made about these Bodies, is, That they require Tersion as well as Attrition; and though I doubt whether the Rule be infallible, yet I deny not but that weaker Electricks re-

quire

quire to be as well wip'd as chaf'ds and even good ones will have their Operation promoted by the same means. And this is very agreeable to our Doctrine, since Tersion, besides that it is, as I have sometimes manifestly known it, a kind or degree of Attrition, frees the Surface from those adherences that might choak the pores of the Amber, or

at least hinder the emanation of the steams to be so free and copious as o-

therwise it would be.

4. 'Tis likewise observ'd, That whereas the Magnetical Steams are so subvile, that they penetrate and perform their Operation through all kind of Mediums hitherto known to us; Electrical Steams are like those of some odoriferous Bodies, easily check d in their progress, since 'tis affirm'd by Learned Writers, who say they speak upon particular Trial; that the interposition of the finest Linnen or Sarsnet is sufficient to hinder all the Operation of excited Amber upon a Scraw or Feather placed

plac'd never so little beyond it.

5. It has been also observed, that the effects of Electrical Attraction are weaken'd if the air be thick and cloudy; and especially if the Southwind blows: And that Electricks display their vertue more faintly by night than by day, and more vigorously in clear weather, and when the winds are Northerly. All which the Learned Kircherus asserts himself to have found true by experience; insomuch that those bodies that are but faintly drawn when the weather is clear, will not, when 'tis thick and cloudy, be at all moved.

6. We have also observed, That divers Concretes, that are notably Electrical, do abound in an effluviable matter (if I may so call it) which is capable of being manifestly evaporated by heat and rubbing. Thus we see, that most Resinous Gums, that draw light bodies, do also, being moderately solicited by heat, (whether this be excited by the fire, or by Attrition or Contust-

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on) emit steams. And in pieces of Sulphur conveniently shaped, I found upon due Attrition a Sulphureous stink. And that piece of Amber which I most employ, being somewhat large and very well polith'd, will, being rub'd upon a piece of woollen cloth, emit steams, which the nostrils themselves may perceive; and they sometimes seem to me not unlike those that I took notice of, when I kept in my mouth a drop or two of the diluted Tindure (or Solution of the finer parts) of Amber made with Spirit of Wine, or of Sal Armoniac.

7. It agrees very well with what has been faid of the corporeal Emanations of Amber, that its attractive power will continue some time after it has been once excited. For the Attrition having caus'd an intestine commotion in the parts of the Concrete, the heat or warmth that is thereby excited ought not to cease, as soon as ever the rubbing is over, but to continue capable of emitting.

Effluvia

Effluvia for some time afterwards, which will be longer or shorter according to the goodness of the Electric, and the degree of the Antecedent commotion: which joyn'd together may sometimes make the effect considerable, insomuch that in a warm day, about noon, I did with a certain body, not much, if at all, bigger than a Pea, but very vigorously attractive, move to and fro a Steel Needle freely poysed, about three minutes (or the twentieth part of an hour) after I had lest off rubbing the Attrahent.

8. That it may not seem impossible, that Electrical Effluvia should be able to infinuate themselves into the pores of many other bodies, I shall adde, that I found them subtile enough to attract not onely Spirit of Wine, but that shuid aggregate of Corpuscles we call Smoak. For having well lighted a Wax-taper, which I preferr'd to a common Candle to avoid the stink of the snuff, I blew out the slame; and, when the smoak ascend-

ascended in a slender stream, held, at a convenient distance from it, an excited piece of Amber or a 'chased Diamond, which would manifestly make the ascending smoak deviate from its former line, and turn aside, to beat, as it were, against the Electric, which, if it were vigorous, would act at a considerable distance, and seemed to smoak for a pretty while together.

9. That 'tis not in any peculiar Sympathy between an Electric and a body whereon it operates, that Electrical Attraction depends, seems the more probale, because Amber, for instance, does not attract onely one determinate fort of bodies, as the Loadstone does Iron, and those bodies wherein it abounds; but as far as I have yet tried, it draws indifferently all bodies whatfoever, being plac'd within a due distance from it, (as my choicest piece of Amber draws not onely Sand and Mineral Powders, but Filings of Steel and Copper, and beaten Gold it self) pro-

provided they be minute or light enough, except perhaps it be fire: I employ the word perhaps, because I am not yet so clear in this point, For having applied a strong Electric at a convenient distance to small fragments of ignited matter, they were readily enough attracted, and shin'd, whilst they were sticking to the body that had drawn them: But when I look'd attentively upon them, I found the shining sparks to be, as it were, cloath'd with light ashes, which, in spite of my diligence, had been already form'd about the attracted Corpuscles, upon the expiring of a good part of the fire; so that it remain'd somewhat doubtful to me, whether the ignited Corpuscles, whilst they were totally such, were attracted; or whether the immediate objects of the Attraction were not the new form'd ashes, which carried up with them those yet unextinguished parts of fire, that chanc'd to be lodg'd in them. But, as for flame, our Countreyman Gil16 Df the Wechanical Dzigine

Gilbert delivers as his Experiment, That an Electric, though duly excited and applied, will not move the flame of the slenderest Candle. Which some will think not so easie to be well tried with common Electricks, as Amber, hard Wax, Sulphur, and the like unctuous Concretes, that very easily take fire: Therefore I chose to make my Trial with a rough Diamond extraordinarily attractive, which I could, without injuring it, hold as near as I pleas'd to the flame of a Candle or Taper; and though I was not fatisfi'd that it did either attract the flame, as it visibly did the smoak, or manifestly agitate it; yet granting that Gilbert's Affertion will constantly hold true, and fo, that flame is to be excepted from the general Rule, yet this exception may well comport with the Hypothesis hitherto countenanc'd, fince it may be said, as 'tis, if I mistake not, by Kirkerus, that the heat of the flame diffipates the Effluvia, by whose means the Attractitraction should be perform'd. To which I shall adde, that possibly the Celerity of the motion of the Flame upwards, may render it very difficult for the Electrical Emanations to divert the Flame from its Course.

10. We have found by Experiment, That a vigorous and well excited piece of Amber will draw, not onely the powder of Amber, but less minute fragments of it. And as in many cases one contrary directs to another, fo this Trial suggested a further, which, in case of good success, would probably argue, that in Electrical Attraction not onely Effluvia are emitted by the Electrical pody, but these Effluvia fasten upon the body to be drawn, and that in fuch a way, that the intervening vifcous strings, which may be supposed to be made up of those cohering Effluvia, are, when their agitation ceases, contracted or made to shrink inwards towards both ends, almost as a highly stretch'd Lute-string does when 'tis permitted to retreat into **fhorter**

18 Df the Wechanical Dzigine

shorter Dimensions. But the Conjecture it self was much more easie to be made than the Experiment requifite to examine it. For we found it no easie matter to suspend an Electric, great and vigorous enough, in fuch a manner, that it might, whilft suspended, be excited, and be so nicely poised, that so faint a force as that wherewith it attracts light bodies should be able to procure a Local Motion to the whole Body it felf. But after some fruitless attempts with other Electricks, I had recourse to the very vigorous piece of polish'd Amber, formerly mention'd, and when we had with the help of a little Wax suspended it by a silken thread, we chafed very well one of the blunt edges of it upon a kind of large Pin-cushion cover'd with a course and black woollen stuff, and then brought the Electric, as foon as we could, to fettle notwithstanding its hanging freely at the bottom of the string. This course of rubbing on the edge of the Amber we pitch'd upon

upon for more than one reason; for if we had chafed the flat fide, the Amber could not have approached the body it had been rub'd on without making a change of place in the whole Electric, and, which is worfe, without making it move (contrary to the nature of heavy bodies) somewhat upwards; whereas the Amber having, by reason of its sufpension, its parts counterpoised by one another; to make the excited edge approach to another body, that edge needed not at all ascend, but onely be moved horizontally, to which way of moving the gravity of the Electric (which the string kept from moving downwards) could be but little or no hinderance. And agreeably to this we found, that if, as foon as the suspended and well rubb'd Electric was brought to fettle freely, we applied to the chafed edge, but without touching it, the lately mention'd Cushion, which, by reason of its rough superficies and porofity, was fit for the Electrical B 3 Efflu-

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Effluvia to fasten upon, the edge would manifestly be drawn aside by the Cushion steadily held, and if this were flowly removed, would follow it a good way; and when this body no longer detain'd it, would return to the posture wherein it had settled before. And this power of approaching the Cushion by vertue of the operation of its own steams, was so durable in our vigorous piece of Amber, that by once chafing it, I was able to make it follow the Cushion no less than ten or Whether from fuch eleven times. Experiments one may argue, that 'tis but, as 'twere, by accident that Amber attracts another body, and not this the Amber; and whether these ought to make us question, if Electricks may with fo much propriety, as has been hitherto generally supposed, be said to Attract, are doubts that my Defign does not here oblige me to examine.

Some other Phanomena might be added of the same Tendency with those Of the Bechanical Dzigine 21

those already mention'd, (as the advantage that Electrical Bodies usually get by having well polish'd or at least smooth Surfaces,) but the Title of this Paper promising some Experiments about the Production of Electricity, I must not omit to recite, how I have been sometimes able to produce or destroy this Quality in certain bodies, by means of alterations, that appear'd not to be other than Mechanical.

EXPER. I.

And first, having with a very mild heat slowly evaporated about a fourth part of good Turpentine, I found, that the remaining body would not, when cold, continue a Liquor, but harden'd into a transparent Gum almost like Amber, which, as I look'd for, proved Electrical.

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EXPER. II.

Secondly, by mixing two such liquid Bodies as Petroleum and strong Spirit of Nitre in a certain proportion, and then distilling them till there remained a dry mass, I obtain'd a brittle substance as black as Jet; and whose Superficies (where it was contiguous to the Retort) was glossie like that Mineral when polished; and as I expected I found it also to resemble Jet, in being endowed with an Electrical Faculty.

EXPER. III.

Hirdly, Having burnt Antimony to ashes, and of those ashes, without any addition, made a transparent Glass, I found, that, when rubb'd, as Electrical Bodies ought to be to excite them, it answer'd my expectation, by manifesting a not inconsiderable Electricity. And this is the worthier of notice, because, that as a Vitrum

Vitrum Antimonii, that is faid to be purer than ordinary, may be made of the Regulus of the same Mineral. in whose preparation you know a great part of the Antimonial Sulphur is separated and left among the Scorie; fo Glass of Antimony made without additament, may easily, as experience has inform'd us, be in part reduc'd to a Regulus, (a Body not reckon'd amongst Electrical ones.) And that you may not think, that 'tis onely some peculiar and fixt part of the Antimony that is capable of Vitrification, let me assure you, that even with the other part that is wont to flye away, (namely the Flowers) an Antimonial Glass may without an addition of other Ingredients be made.

EXPER. IV.

Fourthly, The mention of a Vitrified Body brings into my mind, that I more than once made some Glass of Lead per se, (which

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I found no very easie work) that also was not wholly destitute of an Electrical Vertue, though it had but a very languid one. And it is not here to be overlook'd, that this Glass might easily be brought to afford again malleable Lead, which was never reckon'd, that I know of, among Electrical Bodies.

EXPER. V.

ber, and warily distill'd it, not with Sand or powder'd Brick, or some such additament as Chymists are wont to use, for sear it should boylover or break their Vessels; but by its self, that I might have an unmixed Caput mortuum; Having made this Distillation, I say, and continued it till it had afforded a good proportion of phlegm, Spirit, Volatile Salt, and Oyl, the Retort was warily broken, and the remaining matter was taken out in a lump, which, though it had quite lost its colour being burnt

burnt quite black, and though it were grown strangely brittle in comparison of Amber, so that they who believe the vertue of attracting light Bodies to flow from the substantial form of Amber, would not expect it in a Body so changed and deprived of its noblest parts: Yet this Caput mortuum was so far from having lost its Electrical Faculty, that it seemed to attract more vigorously than Amber it self is wont to do before it be committed to Distillation.

And from the foregoing Instances afforded us by the Glass of Antimony, we may learn, that when the form of a Body seems to be destroyed by a fiery Analysis that dissipates the parts of it, the remaining substance may yet be endowed with Electricity, as the Caput mortuum of Amber may acquire it; as in the case of the Glass of Antimony made of the Calx and of the Flowers. And from the second Example abovementioned, and from common Glass which is Electrical, we may also learn,

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learn, that Bodies that are neither of them apart observed to be endowed with Electricity, may have that Vertue result in the compounded substance that they constitute, though it be but a sactitious Body.

To the foregoing Experiments, whose Success is wont to be uniform enough, I shall adde the Recital of a furprising Phanomenon, which, though not constant, may help to make it probable, that Electrical Attractions need not be suppos'd still to proceed from the substantial, or even from the essential Form of the Attrahent; but may be the effects of unheeded, and, as it were, fortui-And however, I dare tous Causes. not suppress so strange an Observation, and therefore shall relate that which I had the luck to make of an odd fort of Electrical Attraction (as it feem'd,) not taken notice of (that I know of) by any either Naturalist or other Writer, and it is this.

EXPER. VI.

Hat false Locks (as they call them) of some Hair , being by curling or otherwise brought to a certain degree of drines, or of stiffness, will be attracted by the flesh of some persons, or seem to apply themselves to it, as Hair is wont to do to Amber or Jet excited by rubbing. Of this I had a Proof in such Locks worn by two very Fair Ladies that you know. For at some times I observed, that they could not keep their Locks from flying to their Cheeks, and (though neither of them made any use, or had any need of Painting) from sticking there. When one of these Beauties first shew'd me this Experiment, I turn'd it into a Complemental Raillery, as suspecting there might be some trick in it, though I after faw the same thing happen to the others Locks too. But as the is no ordinary Virtuofa, the ve-

ry ingeniously remov'd my suspicions, and (as I requested) gave me leave to Satisfie my self further, by defiring her to hold her warm hand at a convenient distance from one of those Locks taken off and held in the air. For as foon as she did this, the lower end of the Lock, which was free, applied it self presently to her hand: which feem'd the more strange, because so great a multitude of Hair would not have been eafily attracted by an ordinary Electrical Body, that had not been considerably large, or extraordinarily vigorous. This repeated Observation put me upon inquiring among some other young Ladies, whether they had obferved any fuch like thing, but I found little satisfaction to my Question, except from one of them eminent for being ingenious, who told me, that fometimes the had met with these troublesome Locks; but that all she could tell me of the Circumstances, which I would have been inform'd about, was, that they feem'd to her

to flye most to her Cheeks when they had been put into a somewhat stiff Curle, and when the Weather was frosty *.

* Some years after the making the Experiments about the Production of Electricity, having a defire to try, whether in the Attractions made by Amber, the motions excited by the air had a confiderable Interest, or whether the Effect were not due rather to the Emission and Retraction of Effluvia, which being of a viscous nature may confitt of Particles either branch'd or hookt, or otherwise fit for some kind of Cohesion, and capable of being stretch'd, and of shrinking again, as Leather Thongs are: To examine this, I fay, I thought the fittest way, if 'twere practicable, would be, to try, whether Amber would draw a light Body in a Glass whence the air was pumpt out. And though the Trial of this feem'd very difficult to make, and we were somewhat discouraged by our first attempt, wherein the weight of the ambient air broke our Receiver, which chanced to prove too weak, when the internal air had been with extraordinary diligencepumpt out; jet having a vigorous piece of Amber, which I had caus'd to be purposely turn'd and pol.sh'd

30 Df the Wechanical Dzigine for Electrical Experiments, I afterwards repeated the Trial, and found, that in warm Weather it would retain a manifest power of attracting for feveral minutes (for it stirred a pois'd Needle after above of an hour) after we had done rubbing Upon which encouragement we fufpended it, being first well chafed, in a Glass Receiver that was not great, just over a light Body; and making hafte with our Air Pump to exhauft the Glass, when the Air was withdrawn, we did by a Contrivance let down the suspended Amber till it came very near the Straw or Feather, and perceived, as we expected, that in some Trials, upon the least Contact it would lift it up; and in others, for we repeated the Experiment, the Amber would raise it without touching it, that is, would attract it.

You will probably be the less dispos'd to believe, That Electrical Attractions must proceed from the Substantial Forms of the Attrahents, or rom the Predominancy of this or that Chymical Principle in them; if I acquaint you with some odd Trials wherein the Attraction of light Bodies

dies seem'd to depend upon very small circumstances. And though forbearing at present, to offer you my thoughts about the cause of these surprising Phanomena, I propose it onely as a Probleme to your self and your curious Friends, yet the main circumstances seeming to be of a Mechanical Nature, the recital of my Trials will not be impertinent to the Design and Subject of this Paper.

EXPER. VII.

Took then a large and vigorous piece of Amber conveniently shaped for my purpose, and a downy feather, such as grows upon the Bodies, not Wings or Tails of a somewhat large Chicken: Then having moderately excited the Electrick, I held the Amber so near it, that the neighbouring part of the feather was drawn by it and stuck fast to it; but the remoter parts continued in their former posture. This done, I applyed my fore-singer to these erected downy

downy feathers, and immediately, as I expected, they left their preceeding posture, and applied themselves to it as if it had been an Electrical Body, And whether I offered to them my nail, or the pulpy part of my finger, or held my finger towards the right hand or the left, or directly over, these downy feathers that were near the little Quill did nimbly, and, for ought appear'd, equally turn themselves towards it, and fasten themselves to it. And to shew that the steams that iffued out of fo warm a Body as my finger were not necessary to attract (as men speak) the abovementioned feathers, instead of my finger, I applied to them, after the same manner, a little Cylindrical Instrument of Silver, to which they bowed and fastened themselves as they had done to my finger, though the tip of this Instrument were presented to them in several postures. The like success I had with the end of an Iron Key, and the like also with a cold piece of polish'd black Marble; and sometimes the

the feathers did so readily and strongly fasten themselves to these extraneous and unexcited Bodies, that I have been able (though not easily) to make one of them draw the feather from the Amber it felf.

But it is diligently to be observ'd, that this unusual attraction happened onely whilst the electrical operation of the excited Amber continued strong enough to sustain the feathers. For afterwards, neither the approach of my finger, nor that of the other bodies, would make the downy feathers change their posture. foon as ever the Amber was by a light affriction excited again, the feather would be disposed to apply it felf again to the abovementioned Bodies.

And lest there should be any peculiarity in that particular feather, I made the Trials with others (provided they were not long enough to exceed the sphere of activity of the Amber) and found the Experiment to answer my expectation. I

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I made the Experiment also at differing times, and with some months, if not rather years, of interval, but with the like success.

And lest you should think these Phanomena proceed from some peculiarity in the piece of Amber I employed, I shall add, that I found uniformity enough in the success, when, in the place of Amber, I substituted another Electrick, and particularly a smooth mass of melted Brimstone.

These are the Phanomena I thought fit to mention at present of this unusual way of drawing light bodies, and with this Experiment I should conclude my Notes about Electricity, but that I think it will not be amis before I take leave of this Subject, to give this Advertisement, That the event of Electrical Experiments is not always fo certain as that of many others, being fometimes much varied by feemingly flight circumstances, and now and then by some that are altogether over-look'd. This Observation may receive credit from some of the

the particulars above recited (especially concerning the interest of the weather, &c. in Electrical Phanomena.) But now I shall add. that, not onely there may happen fome variations in the fuccess of Trials made with Electrical Bodies, but that it is not so certain as many think, whether some particular Bodies be or be not Electrical. For the inquisitive Kircherus reckons Crystall among those Gems to whom Nature has denyed the attractive power we are speaking of; and yet I remember not, that, among all the trials I have made with native Crystall, I have found any that was destitute of the power he refuses them. Also a late most learned Writer reciting the Electricks, reckon'd up by our induftrious Countryman Gilbert, and increasing their number by some observed by himfelf, (to which I shall now add, besides white Saphyrs, and white English Amethyfts, the almost Diaphanous spar of Lead Ore) denies Electricity to a couple of transparent Gems, the Cornelion and the Emrald. And I do the less wonder he should do fo to the former, because I have my self in vain tried to make any attraction with a piece of Cornelion so large and fair, that 'twas kept for a rarity; and yet with divers other fine Cornelions I have been ab'e to attract some light bodies very manifestly,

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ly, if not briskly; and I usually wear a Cornelian Ring, that is richly enough endowed with Electricity. But as for Emralds, as I thought it strange that Nature should have denied them a Quality she has granted to fo many other Diaphanous Gems, and even to Crystal, so I thought the affertion deserved an Examen, upon which I concluded, that at least it does not universally and constantly hold true. I had indeed feen in a Ring a Stone of price and great luftre, which, though green, I found to be, (as I guess'd it would prove) vigorously enough Electrical. But this Experiment, though seemingly conclusive, I did not look upon as a fair trial, because the Stone was not a true Emrald. but, which is rare, a green Saphir. I learned by inquiry of the skillful Jeweller that cut it, that it was fo far from having the foftness of an Emrald, that he found it harder than blew Saphyrs themfelves, which yet are Gems of great hardness, and by some reputed second to none, Without therefore conbut Diamonds. cluding any thing from this Experiment, fave that, if the affertion I was to examin were true, the want of an Electrical faculty might be thought a Concomitant rather of the peculiar Texture of the Emrald than of its green colour, I proceeded

to make trial with three or four Emralds, whose being true was not doubted, and found them all somewhat, though not equally, endow'd with Electricity, which I found to be yet more considerable in an Emrald of my own, whose colour was so excellent, that by skilful persons 'twas look'd on as a rarity. And though, by this fuccess of my inquiry, I perceived I could not, as else I might have done, shew the Curious a new way of judging of true and false Emralds, yet the like way may be, though not always certain, yet oftentimes of use, in the estimating whether Diamonds be true or counterfeit, especially. if, being set in Rings, the surest way of trying them cannot conveniently be employed. For whereas Glass, though it have some Electricity, seems, as far as I have observed, to have but a faint one. there are often found Diamonds that have a very vigorous one. And I do not remember I met with any Electrick of the fame bulk, that was more vigorous than a rough Diamond I have, which is the fame that I formerly mentioned to have moved a Needle above three minutes after I had ceased to chase it. And this brings into my mind, that it has been obferved, that Diamonds draw better whilft rough, than they do after they are cut and polish'd,

38 Df the Mechanical Dzigine, &c. polish'd; which seeming to contradict what has been observed by others and by us alfo, that Amber, for instance, attracts more vigorously if the surface be made very smooth than otherwise, it induces me to conjecture, that, if this Observation about Diamonds be true, as some of my trials have now and then inclined me to think it, and if it do not in some cases confiderably depend upon the loss of the (Electrical) Substance of the Stone, by its being cut and ground, the Reason may possibly be, that the great rapidness with which the Wheels that serve to cut and polish Diamonds must be mov'd, does excite a great degree of heat, (which the senses may easily discover) in the Stone, and by that and the strong concussion it makes of its parts, may force it to spend its effluviable matter, if I may so call it, so plentifully, that the Stone may be impoverish'd, and perhaps also, on the account of some little change in its Texture, be rendred lesse disposed to emit those effluvia that are Instruments of Electrical Attraction. But as I willingly leave the matter of Fact to further Trial, fo I do the Cause of it, in case it prove true, to farther Inquiry.

FINIS.

